# Role of Sustainable Development in Indian Cement Industry

*Submitted by*

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# PROJECT REPORT
on
# ROLE OF SUSTAINABLE DEVELOPMENT IN INDIAN CEMENT INDUSTRY

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# TABLE OF CONTENTS

| | | |
|---|---|---|
| 1.0 | EXECUTIVE SUMMARY | 1 |
| 2.0 | INTRODUCTION | 2 |
| 3.0 | SUSTAINABLE DEVELOPMENT | 4 |
| 3.1 | STRATEGIES FOR SUSTAINABLE DEVELOPMENT | 5 |
| 3.2 | GLOBAL SCENARIO | 7 |
| 4.0 | INDIAN CEMENT INDUSTRY | 9 |
| 4.1 | INDUSTRIAL ENERGY-CONSERVATION POTENTIAL | 9 |
| 4.2 | CEMENT MANUFACTURING PROCESS | 10 |
| 4.3 | SOURCES OF GREEN HOUSE GASES | 12 |
| 4.4 | ROLE OF CEMENT INDUSTRY IN SUSTAINABLE DEVELOPMENT | 12 |
| 4.5 | ALTERNATIVES FOR ENERGY CONSERVATION | 13 |
| 4.6 | ENVIRONMENT AND ECONOMIC BENEFITS OF RESOURCE RECOVERY | 15 |
| 4.7 | BENEFITS | |
| 5.0 | ACC & SUSTAINABLE DEVELOPMENT | 16 |
| 5.1 | ENERGY MANAGEMENT IN ACC | 16 |
| 5.2 | ENERGY CONSERVATION MEASURES ADOPTED BY ACC | 18 |
| 6.0 | ENERGY CONSERVATION AT CHANDA CEMENT WORKS - A CASE STUDY | 23 |
| 6.1 | KILN SYSTEM AT CHANDA CEMENT WORKS | 23 |
| 6.2 | MODIFICATION IN CYCLONES FOR POWER SAVINGS | 25 |
| 6.3 | MAJOR OBSERVATIONS | 26 |
| 6.4 | OTHER OBSERVATIONS | 26 |
| 6.5 | COST OF MODIFICATIONS AND SAVINGS | 27 |
| 7.0 | POLICY CONSIDERATIONS | |
| 7.1 | NEED FOR SHIFT FROM PRESENT ENVIRONMENT POLICY | 29 |
| 7.2 | ENVIRONMENT STANDARDS AND IMPLEMENTATION | 33 |
| 7.3 | INCENTIVES FOR ENVIRONMENT FRIENDLY INDUSTRIES | 34 |
| 8.0 | CONCLUSIONS | 36 |
| | ANNEXURE -1 | 37 |
| | ANNEXURE -2 | 38 |
| | ANNEXURE -3 | 39 |
| | ANNEXURE -4 | 40 |

# EXECUTIVE SUMMARY

This report highlights the importance of sustainable development while achieving economic growth. Some of the strategies for sustainable development have been discussed in the report. The report also highlights the role of cement industry vis-à-vis sustainable development.

The contribution made by ACC towards sustainable development have been discussed in the report A case study in one of the ACC's cement plant has been presented, The case study brings out the energy conservation measures taken to bring down the plant's energy consumption. The savings achieved as a result of these energy conservation measures are given below.

| | |
|---|---|
| **Specific heat consumption reduction after Cyclone-4 modification** | **13.7 kcal/Kg cl** |
| **Specific heat consumption reduction after Cyclone-3 modification** | **12.8 kcal/Kg cl** |
| **Sp. power consumption reduction** | **1 kWh/t of cl.** |
| **Total Savings** | **Rs 34.7 Lakhs/yr.** |

In the end some of the policies related to energy conservation and environment protection have been discussed A new excise duty structure has been suggested to act as an incentive for using environment friendly manufacturing processes.

# 0 INTRODUCTION

Concern over the depletion of natural resources and a deterioration of global environment has led to the emergence of the concept *Sustainable Development* - achievement of economic growth while preserving the environment for the benefit of future generations. Wise use of resources, minimizing the release of wastes into the environment, utilizing the residual value in waste materials are some of the ways for achieving sustainable development.

India, and other developing countries cannot remain isolated from these developments. The industrial sector is a major energy consuming sector in India and uses about 50% of the total energy available in the country. In general, the Indian industry is highly energy intensive and there is a lot of scope for improving the energy efficiency. Indian Cement Industry can play an important part in sustainable development because of its unique ability to safely use by-products and wastes as raw materials and sources of energy in the manufacture of cement.

The use of wastes such as scrap tyres, wood waste, sewage sludge, waste oil, residual solvents, oil residues, organic sludge, paints etc. as fuels will help in conserving fossil fuel resources and reducing the quantity of waste currently requiring disposal through landfill and incineration. Industrial by-products such as waste lime from the production of acetylene from calcium carbide, lime sludge from the fertilizer industry, slags from steel plants can be used as alternative raw materials in cement manufacturing. The large amount of heat wasted through exit gases can be used for cogeneration. The cement industry has been regularly taking measures to improve the energy efficiency, in view of the rising energy costs

Policy makers in India, should consider how industries can realistically reduce their green house gas emissions in a competitive global market. Effective

environment standards and enforcement mechanisms are as necessary as public opinion. Options for mitigation should also include economic incentives to eco-friendly industries and products This will go a long way in helping the Indian Cement Industry to play an important role in maintaining industrial ecology. At present there are no such incentives available to the industries using self regulatory measures to curb pollution.

## 3.0 SUSTAINABLE DEVELOPMENT

Concern over the depletion of natural resources and a deterioration of global environment has led in recent years to a greater awareness of our environment and to a review of our patterns of both production and consumption. This awareness was lacking in the 1960's and 1970's, when most of the industries were not much concerned about the environment. But as the government regulations became stringent and a few ecological problems became visible, the awareness and concern of the environment started increasing.

Economic pressures have motivated substantial progress in the more efficient use of primary resources – energy and raw materials. Many countries have realised that to continue to achieve economic progress, we must do more with less. This realization has given rise to the concept of Sustainable Development – the achievement of economic growth while preserving our environment for the benefit of future generations

Although we may be approaching ecological recovery in today's world, the planet as a whole remains on an unsustainable course.

International attention is being increasingly focused on the global environmental issues such as ozone layer depletion, acid rain, global warming, climate change etc. While international co-ordination of policy and action in these areas is important, it should not, however, divert international attention from confronting the pressing environmental and related problems facing developing countries such as land degradation, drinking water, health and nutrition etc. Tackling them would not only improve the environment in a local or national context but would equally contribute towards resolving a no. of issues of global environment concern The concept of environmentally sound and sustainable development must include the fostering of growth, the meeting of basic needs and the provision to all of a life of dignity in a clean, safe and healthy

environment.

Since the Industrial Revolution, the great technological progress and economical achievements have made tremendous contributions to the modern human civilization, but at the same time they have also led to greater risks and crisis which must be solved quickly for the future of mankind.

## STRATEGIES FOR SUSTAINABLE DEVELOPMENT

In order to achieve sustainable development, industry has a major role to play. It should make wise use of renewable and non-renewable resources while managing energy and materials Reduction of wastes, reuse, recycling and recovery of chemical and energy value should be given topmost priority. Other options such as rehabilitating damaged environment and supporting research and development of sustainable technologies should be considered.

Industries have traditionally been set up in an isolated rather than an integrated fashion. Manufacturing plants take in resources, make a product and dispose off waste as best they could in response to regulations. This method of operation assumes that resources will remain abundant and that the environment can continue to tolerate disposal of wastes But as we all know today both of these assumptions are not entirely correct. So it is imperative that the resources are conserved and the demands made on the environment are minimized. Wastes and by-products from one industry instead of requiring storage or destruction may be used as raw materials or sources of energy for other industry. This will not only solve the waste disposal problem but also make available cheaper sources of raw material

Industries should make an effort to reduce the quantities of materials used and to provide products with a longer life span and increased durability. Reusing

the same product will result in loss demand for raw materials and energy and hence less impact on the environment Certain products can also be reprocessed. But it is important that the resources used to recycle a product are not greater than those required to produce it from new materials. The process must be sustainable sustainable. When a product or a material has a fuel or chemical value recovery may be a viable option. It involves the use of waste, as a fuel or a raw material, in producing a product.

Focus should be on changing the technology used to create the goods and services that constitute the world's health. The first step for most companies is to make shift from pollution control to pollution prevention. Pollution control means cleaning up waste after it has been created. Pollution prevention focuses on minimizing or eliminating waste before it is created. Pollution prevention strategies depend on continuous improvement efforts to reduce waste and energy use.

Existing technology base in many industries is not environmentally sustainable. Companies should begin to plan for and invest in tomorrow's technologies. Clean technologies are especially needed in the emerging economies of Asia. Companies must change the way customers think by creating preferences for products and services consistent with sustainability Companies must become educators rather than mere marketers of products.

The rapid growth in emerging economies cannot be sustained in the face of mounting environmental deterioration, poverty and resource depletion. In the coming years, companies will be challenged to develop clean technologies and to implement strategies that drastically reduce the environmental burden in the developing world while simultaneously increasing its wealth and standard of living.

greening of industry, and the relocation of the most polluting activities to the emerging market economies. Thus to some extent the greening of the developed world has been at the expense of the environments in emerging economies. With the rapid economic growth in many developing countries the ecosystem is being degraded. Massive infrastructure development in the developing countries has often had devastating consequences on nature.

With rapid industrial development and human population growth natural resources such as forests, soils, water are being stressed beyond their limits. With increase in agricultural, commercial and residential use of water, scarcity of fresh water may become the most vexing problem in the developing world. Water tables are going down at an alarming rate More than 10% of the world's top soil has been seriously eroded

All these goes on to show that human activity is fast exceeding minimum levels of sustainability on a global scale.

The atmospheric ozone layer, which prevents harmful ultra-violet (UV) radiation from the sun from reaching the surface of the earth, has been depleting. The increase in the amount of UV radiation reaching the earth may result in a higher incidence of skin cancer, eye injury and damage to the immune system. In addition, plant growth both on land and in the sea (algae) may be reduced.

Corporates should lead the way for ensuring a sustainable world As such, sustainable development calls on individuals and organizations to take action that benefits the environment, the economy and society
Options such as Joint Implementation and emission trading should be used for rapid development and implementation of voluntary, cost effective projects between developed and developing countries to reduce, avoid or sequester greenhouse gas emissions. This will help combat the threat of climate change and promote sustainable development Joint implementation refers to efforts undertaken cooperatively between countries or entities within them to reduce net greenhouse gas emissions Such joint efforts can address greenhouse gas reductions through a wide variety of technologies and practices such as substitution of renewable energy technologies for fossil fuel burning technologies, application of improved land use, forestry and agricultural practices etc.

'Technology Transfer' in the context of climate change policy, refers to the process by which energy efficient technologies and processes developed by industrialized nations are made available to less industrialised nations.

Carbon sequestration is another way of reducing greenhouse effect. It refers to the capturing of carbon in a carbon sink (such as the ocean) as a terrestrial sink (such as forests or soils) so as to keep it out of the atmosphere

## 3.2 GLOBAL SCENARIO

Developed countries account for more than 75% of the world's energy and resource consumption and create the bulk of industrial, toxic and consumer waste However inspite of such intense use of energy and materials, the levels of pollution are relatively low in the developed economies. The factors responsible for this paradox are stringent environmental regulations, the

greening of industry, and the relocation of the most polluting activities to the emerging market economies Thus to some extent the greening of the developed world has been at the expense of the environments in emerging economies. With the rapid economic growth in many developing countries the ecosystem is being degraded Massive infrastructure development in the developing countries has often had devastating consequences on nature.

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## INDIAN CEMENT INDUSTRY

The energy price increases resulting from the oil embargo in the early 1970's triggered a drive by the cement industry to reduce fuel costs by becoming more energy efficient. The gains in energy efficiency were achieved by shutting down older, primarily wet process kilns and replacing them with large modern dry process units. Further improvements in energy efficiency were realized in cement manufacturing process by the introduction of energy efficient equipment such as vertical roller mills and roller presses for grinding of raw materials, cement, low pressure drop cyclones etc

The country is facing power shortages ranging from 10 per cent and peak shortages of the order of 15 per cent This trend will continue in the future given the past level of performance by energy supply sectors as well as the growth in demand for energy by end users Further, there is steep hike in purchased energy cost in the recent years which has direct influence on industry's overall production cost In this context, energy conservation has emerged as a powerful tool for maintaining competitiveness and increasing profitability In the national scene, energy efficiency improvement programmes have been considered as logical route to bridge the gap between demand & supply for energy saved is energy produced and investment on energy saving schemes is much cheaper than that required for setting up equivalent power generation facility

## 1.1 INDUSTRIAL ENERGY – CONSERVATION POTENTIAL

Cement industry is highly energy intensive The cement manufacturing process involves reaction at very high temperature However, in recent decades, the cement industry has increased energy efficiency considerably through the installation of very efficient dry process manufacturing technology and other efforts

Indian cement industry accounts for nearly 5-6% of industrial power consumption and is an energy intensive sector next to steel and aluminum. Further, this sector is poised for substantial growth in capacity and as a result, the demand for energy is also expected to increase further. There are about 115 large cement plants and about 300 odd mini cement plants operating in the country. The production process of cement calls for uninterrupted power supply and high quality coal and in the absence of the above and also with the inefficiencies in plant operation, the average energy consumption of this sector is high at 120 kWh per tonne of cement and 0.25 tonne coal per tonne of clinker. With the above specific energy consumption levels the annual consumption of energy in this sector is around 9 billion units of electricity and around 19 million tonne of coal.

Despite being energy intensive (energy cost is 40-45% of overall production cost) the cement industry can be regarded as one sector which has overwhelmingly responded to energy conservation. There has been continuos technology developments in all spectrum of activities of cement production. Thus, while recently built plants have incorporated advanced technologies and have attained level of performance compared to international bench marks, it is the fairly older units that offer substantial scope for improvements in productivity and energy efficiency.

## 4.2 CEMENT MANUFACTURING PROCESS

Raw materials for cement consists of some of the earth's most common and abundant minerals – a blend of limestone, clay and iron ore sand. Limestone is crushed and ground before it is fed to the kiln Raw meal enters from one end into the rotary kiln From the other end, pulverised coal is fired. As the material goes down the kiln it passes through progressively hotter zones towards the

flame Under intense heat, raw materials break apart and recombine to form new compounds. The material that comes out at the firing end of the kiln is called clinker. This hot clinker is passed through a cooler where it is cooled slowly by means of air provided by fans This clinker is then stored in a storage yard.

Clinker and other necessary additives like gypsum, slag, etc. are fed into the cement mills in proper proportion to produce cement Cement is then conveyed by means of special pumps employing compressed air to cement storage silos.

To save energy, most cement plants preheat the raw material, in a series of cyclones with hot exit gases before they enter the kiln. Some preheaters contain a precalciner at the bottom of the tower. Raw material from the last stage cyclone enters the precalciner along with fuel and hot combustion gases. From the preheater or precalciner, raw materials enter the kiln which is slightly inclined and also rotating. To trigger the necessary chemical reaction, raw material must reach 1480° C. The temperature of clinker coming out of the kiln is about 1300° C. Heat is recovered from this red-hot clinker and returned to the kiln and calciner to save energy.

As the combustion gases move up the kiln, counter to the downward flow of raw materials, they also carry with them fine dust particles. Hence pollution control devices, such as Electrostatic Precipitators or bag houses are installed to remove particulates from exit gases before they enter the atmosphere. Many plants return all or a position of the particles collected to the kiln as part of kiln feed.

There are four main processes by which cement is manufactured. These are wet, semi wet, dry and semi dry process All the four processes use similar raw materials and can produce the same products They differ in energy efficiency

because of the method of grinding the raw meal, or in the configuration of pyroprocessing step. In the wet process, finely divided raw materials are mixed with water before being inserted into the kiln In the other three processes, the kiln feed material is in powder form.

## .3 SOURCES OF GREEN HOUSE GASES

Unlike most industries, only about half of the $CO_2$ emissions produced by the cement industry are attributable to combustion of fuels. The calcination of limestone is responsible for 50% of the $CO_2$ emissions produced by the process. Cement manufacturing emits $CO_2$ from combustion of fossil fuel and from calcination of limestone in the raw material during the pyroprocess stage. Emissions from calcination are constant at about 0.54 tons of $CO_2$ per ton of cement while emissions from fuel depend on the type of fuel being burned and fuel efficiency of the process.

The wet process is less fuel efficient and generates more $CO_2$ emissions than the dry process because of the need to remove the added water from the raw mix.

## 4.4 ROLE OF CEMENT INDUSTRY IN SUSTAINABLE DEVELOPMENT

Cement Industry can play an important part in sustainable development because of its unique ability to safely use by-products and wastes as raw materials and sources of energy in the manufacture of cement. The use of wastes as fuels in cement kilns has the potential to significantly reduce the energy cost, conserve fossil fuel resources and provide disposal capacity for wastes. Extended exposure time, thermal stability and high temperatures in the kiln ensure conditions suitable for destroying hazardous organic wastes.

## .5 ALTERNATIVES FOR ENERGY CONSERVATION

### Energy efficiency improvements

This improvement will be primarily achieved by replacing older, less energy efficient kilns with precalciner kilns. Cement manufacturing is very capital intensive and replacement of an old kiln with a new one solely for the purpose of energy savings does not typically provide a reasonable return on investment. But plants can make other investments such as cooler modifications, upgrading of milling systems and installation of high efficiency motors.

### Waste derived fuels

The clinker burning process in the rotary kiln has an optimal temperature profile and sufficient retention time for the destruction to a very high extent of dioxins and furanes. Furthermore, clinker is, to a very great extent, able to bind heavy metals, with the exception of elements thallium and mercury. It is therefore sensible for the cement industry to take over a waste disposal function, for instance by using old tyres, waste oil, refuse, sewage sludge, residual solvents rice husk, coconut husk and similar materials. Besides the disposal function, one thereby achieves a saving in fossil fuels to the extent that the wastes possess a calorific value. Burning energy-bearing, hazardous waste as kiln fuel results in a net decrease in CO2 emissions compared to incinerating the wastes without energy recovery.

### Alternative Raw Materials

There are a number of industrial by-products such as waste calcium hydroxide from the production of acetylene from calcium carbide, whose use would not involve calcination. Lime sludges generated in the fertilizer and paper industry can be used along with limestone as raw material in the cement manufacturing process. This would also solve the waste disposal problem of these industries. Slags from modern steel making, blast-furnace slags, can be used in blended cements or as a replacement for portland cement in concrete The quantities of

these materials that could be used would be limited by their chemical composition.

### Limestone addition

Intergrinding moderate amounts of limestone with clinker has no detrimental effect on performance and may even improve some product characteristics. Countries such as Germany, France, Canada, Japan, Russia and Brazil allow upto 5% limestone to be incorporated in Portland cements. The amount of decrease in CO2 emissions per ton of cement will depend upon the amount of limestone allowed to mix with clinker.

### Supplementary cementitious materials

In recent years, driven by economic considerations, fly ash, granulated blast-furnace slag, and natural and manufactured pozzolans have found increasing use in production of concrete. All these materials can be interground into the cement to give a blended product or they can be added at the concrete mixing stage.

### Cogeneration

Cogeneration of power utilizing waste heat is an attractive proposition for energy conservation. Cogeneration is the simultaneous production of electrical and thermal energy from a single fuel source. In cement plants the exhaust gases are available at a temperature of 380-400 °C. This heat can be utilised in the boilers in power plant to generate electricity. Cogeneration assumes greater significance in the Indian context in view of the power shortages and thereby power cuts in many states which results in production losses and higher energy consumption.

## 4.6 ENVIRONMENT AND ECONOMIC BENEFITS OF RESOURCE RECOVERY

As has already been mentioned, a wide variety of materials can be safely used as alternative or supplementary fuel in the cement kilns. The environmental benefits of resource recovery in cement kilns can be realised because of certain characteristics of the cement manufacturing process.

a) Extended exposure time, thermal stability and high temperatures ensure conditions more than adequate for destroying hazardous organic wastes.
b) Alkaline environment in cement kilns because of the lime generated in the cement making process neutralizes acid gases produced by the burning of hazardous waste.
c) Minimization of ash and other residuals from the fuel which are incorporated in the product itself.

A major advantage of using cement kilns to burn hazardous wastes is the reduced need to build new hazardous waste incineration facilities. The cost of modifying existing cement plants to enable them to use waste as a supplementary fuel would be a fraction of the cost of the large scale investment required to build a system of incinerators to burn hazardous waste. Apart from this, the cement industry will always benefit by the use of cheap energy source.

# 5.0 ACC AND SUSTAINABLE DEVELOPMENT

ACC – the largest cement producer in India, and one of the largest in the developing world is not only concerned but also committed to sustainable development and environment management. ACC's commitment encompasses five major areas – environment protection, environment improvement, process technologies for industrial wastes, rural development and employee welfare.

This concern dates back to the pre-independence period, when there was no statutory obligation to do anything beyond what the immediate interests of business demanded, nor was there any social compulsion. A concerted effort towards energy conservation in ACC started in 1988. Prior to that, ACC actively pursued several programmes directed towards productivity optimization. In 1988, the management launched an energy conservation drive supported by an adequate corporate set-up strategy and finance. The cement produced at ACC through the dry process has increased substantially and the specific thermal and electrical energy consumption have also reduced substantially.

## 5.1 ENERGY MANAGEMENT IN ACC

### ORGANIZATIONAL SET-UP

ACC has set up energy management cells at two levels :

1. CORPORATE LEVEL

The corporate level cell is an apex body consisting of the top level management executives assisted by engineers. It operates from ACC head office at Bombay. The functions of corporate level cell are :

- To monitor the energy consumption trends
- To fix targets for energy consumption
- To devise various medium and long-term energy conservation schemes
- To obtain necessary capital investment sanction

- To monitor the implementation and progress of sanctioned energy conservation schemes.

## 2. WORKS LEVEL

The energy management cell at each works operates under the guidance of the Vice President or Sr. Vice President. These cells have representatives from different departments (e.g. production, maintenance, quality control, instrumentation) with a Process or Industrial Engineer acting as a coordinator. The functions of works level cells are :

- To monitor and control energy consumption.
- To devise and implement short-term energy saving schemes.
- To implement medium and long-term energy conservation schemes proposed by corporate office.

### ANNUAL ENERGY AUDITS

Apart from organizing an energy management structure, ACC annually conducts energy audits at all of its works. The objectives of energy audits are :

- To compare the actual energy consumption against the target for each usage centre.
- To identify the reasons for inefficient use of energy.
- To evolve schemes for energy conservation.

The scope of the energy audits comprises :

- Updating the cost of energy (fuel and power).
- Monitoring of fuel and electrical energy consumption by different types of energy (e. g. fuel, electricity, etc.).
- Monitoring energy consumption by different departments (e. g. crusher, raw mills, kilns etc.)
- Monitoring energy consumption by system and equipment (e. g. fans, compressors).

- Monitoring energy consumption for different products (clinker, cement etc.).
- Preparation of cost-benefit analysis for energy conservation schemes.

Some of the benefits achieved from energy audits are:

1. Power and load factor improvement resulting in substantial savings in the electricity bill.
2. Avoiding underloading of motors/equipment.
3. Minimising false air infiltration
4. Improving productivity through process optimisation. This includes raw mix proportioning and design, use of mineralisers such as fluorides, chlorides, sulphates etc. as flux, optimising cooler compartment flow rates, etc.

## 5.2 ENERGY CONSERVATION MEASURES ADOPTED BY ACC

The various energy conservation measures adopted by ACC during the energy conservation drive from 1988, can be classified into long-, medium- and short-term measures.

The long-term measures are highly capital intensive and involve major changes in process technologies. These involve modernization programmes, replacement or upgradation of equipment and major modifications in the process The medium-term schemes involve improvement and upgradation of the energy intensive unit operations either by modifying the existing machinery or by replacing part of the system by energy-efficient systems now available in the market. The short-term measures require little or no investment. These are identified and implemented at the works level of energy management cell. These measures have resulted in considerable energy savings both thermal as well as electrical energy

Some of the salient features of the energy conservation measures taken by ACC are listed below

- First in the cement industry to introduce water management technology through 'drip irrigation' system, and the application of 'plasticulture' in its environment improvement programme at various locations.

- Switch over from energy intensive wet process to energy efficient dry and semi-dry process, which also helps in our efforts towards energy conservation. ACC Madukkarai Works is perhaps the only cement plant in India which has carried out a process change from wet to semi-dry process with the main aim of achieving energy conservation. The salient features of this conversion are :
- Filtration of wet slurry in drum filters to reduce the moisture from 35 to 14 per cent.
- Drying of the filter cake using waste gases from the kiln.
- Preheater of kiln feed material in a two-stage cyclone preheater using kiln waste gases.
- Reduction of moisture content from 14 per cent to about 1 per cent in the crusher dryer. The pre-calciner known as NMFC (New Mitsubishi Fluidized Calciner) has enabled usage of low grade fuels in the kiln.

  The plant at Lakheri has been recently converted from wet to dry process. In Kymore all the five old wet process kilns have been replaced with modern dry process kilns.

- Process modifications with the aim of energy conservation. The preheater cyclones at Chanda Cement Works has been recently converted to low pressure drop cyclones. The plant at Kymore uses DDF as calciner. Almost 60% of the total fuel requirement is fed to the calciner. This results in reduced Nox emissions as the fuel is burnt at relatively low temperature (calcination temperature). Vertical roller mill has been installed at Sindri, Gagal and Chanda Cement Works. In addition to these major modifications many other modifications has been carried out in ACC's plants which has resulted in

considerable energy savings and productivity improvements.

- Use of alternative raw materials such as lime sludges. Lime sludges get produced as wastes/by-products in various industries such as paper and pulp, fertilizer, etc. It is certainly desired that this lime sludge be converted back to lime for reuse. This can be achieved by calcining the lime sludge by a suitable process. This conversion of lime sludge to lime not only provides an important raw material for use in various applications, it also takes care of the waste disposal problems faced by the industries generating this sludge and provides a cleaner environment.

  Considering the nature of lime sludge that contains finely precipitated calcium carbonate, ACC has evaluated the Gas suspension drying, pre heating and calcination route for lime calcination using fluidised bed calciner. This process was established by undertaking extensive laboratory and pilot plant studies at its Research & Consultancy Directorate.

  The plant at Madukkarai with a capacity of 2000 TPD operates using the gas suspension calcination system described above. This plant has been designed and installed by ACC with its in house developmental efforts & experience and it produces cement using low grade limestone. Low grade limestone is beneficiated using the froth floatation process and filtered. This improves the quality of raw material fed to the kiln thereby reducing the fuel consumption.

  ACC also had set up earlier a cement plant of capacity 300 TPD at Sindri based on waste lime sludge from near by fertilizer industry. This lime sludge was a byproduct of the Ammonium Sulphate plant which was produced from the phospho-gypsum In this plant cement was manufactured for over two decades.

- Shift from calcined clay to flyash from thermal power plants for blended cement

(Wadi, Kymore, Madukkarai, Gagal)

Use of agricultural residues like rice husk and coffee shells for firing in the kiln as a partial replacement of coal (Chanda and Madukkarai). Coal is the main fuel used by the Indian cement industry. There has been a progressive deterioration in the quality of coal supplied to the cement industry. The Indian cement industry has often been receiving coal of upto 40-45% ash content and calorific value of upto 3800-4000kcal/kg. Deterioration and inconsistent quality of coal has become a limiting factor for improving the productivity of Indian cement industry.

To face the national challenge of depending sources of fossil fuels the management at ACC Madukkarai has encouraged the use of alternate or cheaper sources of energy. These include use of rice husk, groundnut husk and lignite. Depending on availability, rice husk is being used after blending it with coal and lignite. Special efforts were made to modify the grinding system to utilize rice husk. Experiments were carried out to use coconut husk but it was not feasible to use it because of its low calorific value. Presently, trials are underway for using groundnut husk and coffee husk.

Special efforts have also been made to use lignite as it is readily available from Neyveli Lignite Corporation. With the recent modifications and better design of the mill system lignite usage has gone up from 10 to 50 per cent of coal consumed. Increased use of alternate energy sources such as rice husk and cheaper sources of energy such as lignite conserve our precious coal reserves

Exclusive production of blended cement based on blast furnace slag from steel plants, as a solution to the problems of dumping solid waste from these plants (Jamul, Sindri, Chaibasa) ACC today is not only India's largest cement producer but also the leader in a variety of blended and other special cements. The plant at Jamul produces slag cement by blending clinker with slag generated from nearby steel plant. Slag constitutes almost 50% of the final product. This results in a considerable reduction in CO2 emissions as the slag is used after the calcining stage.

100 per cent recycling of dust from wet process plant kiln with ESPs to save on a resource like limestone (Chaibasa, Lakheri).

Mines rehabilitation and reclamation carried out at ACC's Mancherial, Jamul, Bhupendra, Kymore, Lakheri and Madukkarai minesconsist of back filling of mined area, levelling, re-contouring, landscaping to merge with topography and revegetating the area with plant species suited to the agro-climate of each region. At Mancherial and Jamul mines, picnic spots with parks, recreation and boating facilities, and bird sanctuaries have been developed.

Compensatory afforestation in lieu of reserve forest needed for mining in Walayar area loacated 22 km away from Madukkarai works, was carried out over an area of 67.75 hectares successfully with a survival rate of over 90 %, despite this being a drought-prone area. The afforested area has been handed over to the forest department in July 1991, but the upkeep and maintenance of the same is continued to be done by ACC at the request of the forest department.

- Celebration of 'van mahotsava', a mass movement to foster the 'green' habit' (Lakheri).

- The only cement company to partially sponsor 'Green India 2047 – the role of the corporate sector', a major pathbreaking study on the extent of degradation of natural resources between 1947 and 1997, launched by Tata Energy Research Institute.

The fruits of these efforts have been underscored in several awards. The first award for mineral conservation and environmental issues went to Gagal and Madukkarai mines. The forest officials in Tamil Nadu are happy with compensatory afforestation work in Madukkarai, and refuse to take repossession. The mile-long garden, the lake and greenery around Mancherial have earned ACC the "Jawaharlal Nehru Memorial National Award for Pollution Control and Energy Conservation."

## 6.0 ENERGY CONSERVATION AT CHANDA CEMENT WORKS - A CASE STUDY

An energy audit study was carried out in our Chanda Cement Works recently with an objective of assessing the plant's energy consumption pattern and identifying energy conservation opportunities. The plant is located near Chandrapur in Maharashtra. It draws power from MSEB and the power consumption is of the order of 7 million units per month. Coal is received from nearby WCL mines and its consumption is around 13000 MT per month.

During the energy audit study actual electricity consumption was measured with portable power analysers. The percentage share of electricity consumption of various sections of the plant is shown in Figure-1. As can be seen in the above figure raw mills, kiln and cement mills sections account for 92% of the total process power consumption of the plant. Various energy conservation measures have been identified during the study and the same is listed in Annexure-1. We have implemented recently one of the major recommendations i.e., modification in preheater cyclones in the kiln section and have achieved good energy savings. We present below the case study of the above energy conservation measure.

## 6.1 KILN SYSTEM AT CHANDA CEMENT WORKS

Chanda Cement Works which is in the production of cement since 1970 has two lines of similar kilns incorporating dry process technology. The rated capacity of each kiln is 1000 tpd clinker and is designed with 4-stage cyclone suspension preheaters with Mitsubishi fluidised bed calciner.

The key process in making cement is the 'burning' or calcining of the raw materials in the pyroprocessing section which consists of preheaters, precalciner and rotary kiln. The typical pyroprocessing system is shown in

figure-2. Preheaters consist of ducts and cyclones and are employed for heat recovery from upcoming hot gases to preheat the raw material thereby largely improving the heat economy. The preheaters are not just recuperative devices added to a kiln but is actually a part of the system where chemical reactions and physical changes occur as the raw materials flow down to precalciner and then to kiln. Precalciner is a vessel (NMFC calciner) where 50-60% of fine coal is fired and raw material is calcined to around 90%. The remaining 10% calcination and clinker formation takes place in rotary kiln where 40-50% of fine coal is burnt.

In the preheater-precalciner kiln, the main stream of process gas is set to motion by the induced draft fan, which consumes a driving power of 8-16 kWh/tonne of clinker produced depending upon the system efficiency. This amounts to 30-50% of the total power consumed in the pyroprocessing system. There are several ways to reduce power consumption, for instance to limit the rate of gas flow through the system, or to reduce pressure loss at each unit confirming to the system such as cyclones, precalciner and kiln. We have modified the cyclones to reduce pressure drop and improve energy consumption level.

The cyclones in the preheating part are classified into two types according to their function and the shape. The top cyclone located at the top most position of the preheater is designed with long cylindrical and steep conical portion to prevent raw meals from being carried out with the exhaust gas. Generally twin cyclones of small diameter for high collection efficiency, are arranged in parallel position. The gas temperature is 300~400 °C and the units are installed without refractory linings. On the other hand, the lower and intermediate cyclones are designed with compact sizing to produce low pressure drop. They have short cylindrical, and less steep conical portions which result in decreased height of the cyclone. The temperature of the gas is 500~900 °C and the cyclones are

installed with refractory linings In cases when cyclones show poor collection performance, the amount of raw meal circulation inside the preheater increases which leads to higher fuel consumption Therefore, the criteria for high efficiency cyclone is that the cyclone should have low pressure drop, high collection efficiency and be compact in design. By meeting these criteria, an improvement in the pressure drop, the exhaust gas temperature, the heat consumption, the exhaust gas dust discharge, etc. can be achieved. The reduction in pressure drop not only results in direct power savings but also releases the fan capacity for production increase.

## 6.2 MODIFICATION IN CYCLONES FOR POWER SAVINGS

Based on the energy audit study carried out in Chanda Cement Works we have identified that lower stage cyclones 3&4 in the preheater stream had higher pressure drop leading to higher preheater outlet draft of 660 mmwg. The waste gas fan is connected with a motor of rating 895 kW and was consuming around 700 kW power. Keeping in view the power savings potential, cyclones modification was suggested for implementation. Subsequently, we have carried out the necessary modifications in our Kiln No-2 in two stages. In the first stage, cyclone no. 4 was changed with modified design and in the second stage cyclone no 3 was modified. In both the cases the cone portions of the old cyclone were retained However for cyclone no.4 the cone was shifted by 300 mm away from the kiln in order to accommodate the involute portion In case of cyclone no.3 the cone was retained in the original position only. The modification is basically in the cylindrical portion of the cyclones as well as in the gas inlet ducts. The modified design was prepared through ACC's internal expertise.

The process parameters before and after modifications to both the cyclones are given in Annexure-2.

## 6.3 MAJOR OBSERVATIONS

Following are the major observations on the process parameters resulting from the modifications:

1. The total pressure drop in the preheater system decreased from the level of 655 mm to 539 mm resulting in a reduction of 116 mm.
2. The preheater outlet temperature decreased from 420 °C to 382 °C. The kiln feed rate increased from 72 tph to 76 tph on an average. This corresponds to an increase in the kiln output rate of around 55 tpd.
3. Specific gas volume decreased from 2.3 NM$^3$/Kgcl to 1.96 NM$^3$/Kgcl.

## 6.4 OTHER OBSERVATIONS

1. Though the pressure drop in cyclone no.4 was reduced from 205 mm to 142 mm after the first stage modification, the above pressure drop subsequently increased to 190 mm after the modification to cyclone no.3 also. This is because of the increased output level from the kiln achieved after modification to cyclone no.3.
2. The pressure drop in cyclone no 3 came down from the level of 155 mm to 105 mm after the modifications to cyclone no.3, thus, there is a reduction of 50 mm pressure drop in cyclone no.3.
3. It was also observed that the pressure drop across the cyclone no 2 came down from a level of 125 mm to 77 mm after the modification to cyclone no 4 &3. This reduction is probably due to lower carry over from the bottom stage cyclones because of better efficiency of cyclone no 3&4. This is also supported by the calcination levels found at the discharge of the top stage cyclones, which

have come down after the modifications

4. In general, there is reduction of gas temperatures at the outlet of all stages indicating better heat-transfer in the preheater.

## 6.5 COST OF MODIFICATIONS AND SAVINGS

The total cost of the modifications of both the cyclones works out to Rs. 22.81 Lakhs. After modifications to the cyclones the preheater outlet temperature has come down by about 38°C which at a specific gas volume of 2 NM3/kg clinker is equivalent to a saving of 27 kcal/Kg of clinker of thermal energy thus working out to Rs 24 0 Lakhs per annum In the electricity side, due to reduction in pressure drop in preheater, there has been a saving of 1 kWh per tonne of clinker in the power consumption of waste gas fan which is equivalent to Rs. 11 Lakhs per year. Thus the total savings actually realised is Rs. 35 Lakhs per year. The saving in power could have been much higher if the variable speed fluid coupling for the waste gas fan were in operation. At present the same is under repairs and the waste gas fan flow is being regulated by damper control. Since we are operating the damper at around 60% opening only, there is substantial loss in power across the damper. This will be eliminated once the fluid coupling is installed after repairs. It is envisaged that after installation of variable speed fluid coupling the fan power consumption will be further reduced and potential for savings is expected to be around 190 kW. This will be equivalent to a reduction in specific power consumption of 4.4 kW/T of clinker (12% reduction in kiln section power consumption) and a monetary savings of Rs. 48 Lakhs per year (Refer Annexure-3). Thus, the total savings potential in both thermal and electrical energy consumption reduction will be to the tune of Rs. 71 Lakhs per year Further, the savings given above do not include the additional realisation because of additional clinker production to the tune of about 55 tpd The details of savings are given in Annexure-4.

Encouraged with the successful results and substantial energy savings, the modification work in similar kilns in other Works of ACC is planned for implementation. A proposal to replace the existing 4-stage preheater at Chanda Cement Works with a 6-stage preheater tower to bring down the fuel consumption to 740 kcal/kgcl Is also under consideration

# 7.0 POLICY CONSIDERATIONS

## 7.1 NEED FOR SHIFT FROM PRESENT ENVIRONMENT POLICY

Theoretically speaking, environmental policy can be defined as " the sum of objectives and measures designed to regulate society's interaction with the environment as a natural system; it comprises aspects of rehabilitation, conservation, and structural adjustment" Practice, however, does not conform to such a comprehensive definition. Only parts of the inter-action between society and environment have become the subject of policy. So far, environmental policy has mostly been designed as react-and cure strategies concerning air and water pollution, noise and waste, with emphasis on the rehabilitation aspect.

For a variety of reasons, this conventional environmental policy was, and is still, meaningful and very much necessary. It has however, a number of shortcomings, some of which are addressed in the following, along with some suggestions for overcoming them through preventive environmental policy, i. e. anticipate and prevent strategies

Since the beginning of the 1970s, when systematic records first began to keep track of the funds allocated for environmental protection, in the industrialized countries the sum of the respective public and private investments has reached large proportions. The industrial society thus appears to be "paying through the nose" back payments for the negative environmental impacts of production accumulated in the past

On the one hand, high environmental investments give cause for proud political statements about the successes of environmental protection, according to the

motto "the more, the better" On the other hand, they are – presumably-the absolute minimum of what is necessary to secure industrial society's sustainability. At the same time, they may symbolize a serious structural deficiency of industrial society: Environmental protection expenditures are spent when damage to the natural environment has occurred and can no longer be denied. Therefore, it is necessary to always confront the "success stories" of environmental protection expenditures with figures on the environmental damages themselves.

There are more shortcomings of the conventional environmental policy. To name the more obvious ones: Environmental policy often identifies the given problems too late, so that ecosystems affected cannot survive. As it is pursued as a media-specific policy, i. e. separately regulating air or water quality, noise or waste, it also lacks coordination between its specific goals, measures and institutions. And this then may result in shifting a problem from one environmental medium to another, e. g., from air to water or soil, or from one place to another, as is the case with long-range trans-boundary pollution. Thus, innovations in policy planning and implementation are needed. Preventive environmental policy, it seems, can counter the shortcomings of conventional environmental policy.

### Environmental Impact Assessment (EIA) as part of preventive environmental policy

Acceleration of technical knowledge and public awareness can, of course, be promoted through a variety of approaches and methods, but depends a great deal on the specific environmental issue at hand. Environmental Impact Assessment (EIA) are increasingly being applied, not only for public but also for private investment projects They entail efforts to learn more about possible

environmental impacts, and are intended to allow appropriate action to be taken before damage has occurred In that sense, environmental impact assessments can be classified as part and parcel of preventive environmental policy.

### Ecological Economic Policy as a part of preventive environmental policy

Confronted with serious environmental damage, conventional economic policy has increasingly been challenged Its guiding principles, goals, instruments, and institutions are being questioned, and a new concept is emerging: ecological economic policy

Conventional economic policy is based on the guiding principle of maximising flows: volume of production, income, profits, turnover. Instead, the "ecological economy" would be based on a different guiding principle, i.e., "increasing efficiency and maintaining sub-stencil!" Aspects such as environmental compatibility and resource conservation would become important, and structural adjustment of products and technologies according to ecological considerations would become the task.

Regarding goals, it seems necessary to re-assess and redefine the growth targets and to include "environmental stability" into the catalogues of economic policy goals.

Conventional economic policy relies mainly on two instruments, i. e. variations of interest rates and of tax rates. From an ecological point of view, new taxes and charges are required which, to some extent, should replace traditional taxes. In a situation of structural unemployment and environmental pollution the introduction of resource taxes (e g , an energy tax) and emission charges (e. g., charges on $SO_2$, $NO_x$, and $CO_2$ emissions), and a definite decrease of wage

taxes is called for. Such a structural tax reform would change the existing incentives in the economy towards accelerating resource efficiency and increasing employment opportunities.

### Cleaner Production – a new approach to industrial environmental policy

For the past thirty years in industrial activities, "end-of-pipe" pollution control devices have been developed. Although those processes are useful and indispensable in the short term, their investment and running costs are high.

The development of "cleaner production" patterns means a commitment of all parts of society, and, in particular, a close co-operation between government and industry. It means also an involvement of all, at all levels.

It is industry's task to define cleaner production policies and programmes, with clear timetables and goals. Such programmes should include two complementary approaches (1) implementation of cleaner technologies, (2) good management practices, involving all personnel.

### Implementation of cleaner technologies

Five main kinds of changes can be considered in a cleaner production approach:

- Redesign and / or reformulation of products.
- Process modification.
- Changes in plant equipment.
- Raw or toxic material substitution.
- Simple operating and housekeeping processes.

### Management practices

Good management is the "glue" that holds the technical measures together. Good management is impossible without high-level support in the company, and

without a clearly articulated environment policy Only then will all personnel know what is expected to them, and will be fully committed to achieve "cleaner production". Lack of maintenance of equipment is one major source of potential pollution and accidents.

Training programmes for workers on the production line and other staff to increase awareness and action is an important element of good management practice for environmentally sound operations.

## 7.2 ENVIRONMENT STANDARDS AND IMPLEMENTATION

One of the most common approaches to environmental protection has been the issuance of environmental standards. An environmental quality standard defines the level of a particular pollutant in the air or water, possibly in terms of volume or a concentration level. Advantage of environmental standards is that they are enforceable in the courts. There is a greater likelihood that the broad environmental goals will actually be met than if the compliance was left to voluntary action. But one of the major disadvantage is that the national standard may be difficult or impossible to implement adequately across diverse industries, geographic locations and technologies. These obstacles may lead to either a watering down of the standard or a series of variances or ruling that permit exceptions from the standard

A second disadvantage is the heavy reliance on the administrative agency that is charged with enforcing the law. Often laws are weakened or undermined by poor administrative enforcement which may itself be the result of limited resources, enthusiasm or political will Across the board standards may also cause inequity and suffering because each business faces a different pollution control problem. Older, less efficient plants face problems because it is often costly to renovate

them, while building a new, non-polluting plant may not be justified because of capital costs or market conditions.

## 7.3 INCENTIVES FOR ENVIRONMENTALLY FRIENDLY INDUSTRIES

The Government of India has from time to time, constituted expert groups to examine specific aspects of environmental policy and recommend appropriate policy measures. There is a growing realisation that fiscal and administrative incentives would accelerate the process of prevention of environmental damage. Some of the incentives which the industry deserves are presented below.

1. Concessional excise duty and concessional customs duty for pollution control equipment should be given.

2. 100% depreciation should be allowed for all the equipment engaged in pollution prevention.

3. Customs duty for filter bag should be reduced for economical import of efficient filter bag materials.

4. Joint Implementation should also be introduced as a self regulatory measure to minimise environmental damage.

5. National and International financial institutions should provide soft loans for equipment financing to encourage industries for environmental damage prevention.

6. Import duty on spares used for the pollution control equipment should be reduced.

7. Monitoring of emission level with on-line monitoring instruments should be encouraged for continuos performance checking of the equipment The cost of such on-line equipment being high, incentives such as tax exemptions/ subsidies should be made available.

8. Each major industrial process should be reviewed to identify the R&D efforts required to reduce energy consumption

9 . A system of governmental recognition and awards should be instituted for honouring individuals and organisations for outstanding performance in environmental management

10. Government and other nodal agencies should formulate schemes for educating and training industrial personnel in pollution prevention through various national level programmes.

11. Formal training courses for developing environmental expertise should be introduced in various technical institutions to maintain a steady flow of experts in the field.

12 The excise duty structure can be split into two parts; one fixed and the other variable depending on the environment compatibility of the product. This will act as an incentive for using environment friendly methods of manufacturing a product. Today, the environment friendly products have to compete at par with other products. Such companies do not have any incentive for the efforts and the risks taken for manufacturing these products. Such policies will go a long way in encouraging these compamies to continue their efforts in making their products and processes mor environment friendly.

## 8.0 CONCLUSIONS

The concept of Sustainable Development has been studied. In order to continue achieving economic growth it has become imperative to preserve our environment and use our resources as efficiently as possible.

There is a great potential for the cement industry to contribute towards sustainable development. Process diagnostic studies and energy audits should be carried out regularly to identify the energy conservation measures and improve the energy efficiency of the plant. There are number of energy saving schemes that have been established for their saving potential and it is the responsibility of management of any industry to install such systems for the overall benefit. These measures can be divided into short term and long term measures depending upon the capital investment required for the implementation of these measures. Such studies will not only contribute towards sustainable development but will also result in considerable savings for the organization. The economic benefits of these studies can be seen from the results of Chanda case study.

In addition to the energy audit studies, there is an urgent need today for focused research efforts towards identifying the wastes that can be used as an alternative source of fuel and raw material in the Cement Industry. With the ever increasing energy costs, the Cement Industry is looking for cheaper alternative fuel sources.

With these measures the Cement Industry can play a very important role in achieving Sustainable Development.

ANNEXURE -1

# LIST OF MAJOR ENERGY CONSERVATION MEASURES IDENTIFIED THROUGH ENERGY AUDIT

Modification of existing lower stage cyclones in the preheater of the kiln to reduce pressure drop for power savings in waste gas fan.

Installation of bucket elevator system for kiln feed material conveying in place of pneumatic conveying for savings in electrical energy.

Replacement of existing inefficient cooler ID fan by high efficiency fan for savings in electricity.

Arresting false air entry in kilns for savings in power and coal.

VVVF controllers for variable speed mode of operation of cooler fans to achieve power savings in fans.

Pipe conveyors for transportation of cement to storage silo in place of pneumatic conveying which would result in electricity savings.

Installation of capacitor banks for power factor improvement.

Installation of bag filter in place of electro static precipitator in fine coal circuit to reduce dust emission level and to minimise fine coal wastage.

## ANNEXURE-2

# MAJOR PROCESS PARAMETERS OF KILN NO.2

| LOCATION | Before modification | | | | After modification of only Cy-4 | | | | After modification of Cy-3 and Cy-4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Temp °C | St Pr mm Wg | % Cal | Δp mmWG | Temp °C | St Pr mm Wg | % Cal | Δp mmWG | Temp °C | St Pr mm Wg | % Cal | Δp mmWG |
| kiln Inlet | 984 | 5 | - | - | 980 | 4 | - | - | 950 | 5 | - | - |
| MFC outlet | 844 | 85 | 70 | 80 | 839 | 76 | 70 5 | 72 | 838 | 80 | 70.6 | 75 |
| Cy-4 I/L | - | - | - | - | - | 136 | - | - | - | - | - | - |
| Cy-4 O/L | 848 | 290 | 92 3 | 205 | 828 | 218 | 84 5 | 142 | 721 | 270 | 87 6 | 190 |
| Cy-3 O/L | 740 | 445 | 40 9 | 155 | 698 | 366 | 31 2 | 148 | 676 | 375 | 29 88 | 105 |
| Cy-2 O/L | 620 | 570 | 24 6 | 125 | 607 | 477 | 15 7 | 111 | 598 | 452 | 11.76 | 77 |
| Cy-1 O/L | 420 | 660 | 11 9 | 90 | 400 | 557 | 7 6 | 80 | 382 | 544 | 5 52 | 92 |
| Total Δp in preheater system mmWG | 655 | | | | 553 | | | | 539 | | | |
| Kiln feed rate TPH | 71 8 | | | | 72 | | | | 76 | | | |
| Kiln coal TPH | 3 4 | | | | 3 3 | | | | 3.3 | | | |
| MFC coal TPH | 5 4 | | | | 5 0 | | | | 5 8 | | | |
| Sp air consumption | 2 3 $Nm^3$/kg cl | | | | 2 0 $Nm^3$/kg cl | | | | 1 96 $Nm^3$/kg cl | | | |

ANNEXURE-3

## SAVINGS POTENTIAL ESTIMATION IN WG FAN AFTER INSTALLATION OF FLUID COUPLING

Specific air flow before modification : 2.3 $NM^3$/Kg clinker
Draft before modification : 660 mmwg
Actual power consumption WG fan : 700 kW

Specific air flow at fan inlet after modification : 1.96 $NM^3$/Kg clinker
Draft at fan inlet after modification : 544 mmwg
Temperature of gas at preheater outlet : 382 Deg C

Air flow at fan inlet . 4.961 $M^3$/Kg clinker

Clinker production rate : 44 T/H or 733.3 Kg/min.

Air flow rate : 4.961*733.3 $M^3$/min.
: 3637.9 $M^3$/min

Theoretical fan air power : Q*P/6120 kW
: 3637.9*539/6120
: 321 kW

Estimated actual motor power : 321/$\eta$ fan /$\eta$motor
: 321/0 75/0.85
: 506 kW

Power savings potential : 700-506 kW
: 194 kW

Potential for reduction in sp. power consumption : 4.4 kW /Tof clinker

Annual monetary savings potential : Rs. 48 Lakhs

ANNEXURE-4

# COST BENEFIT ANALYSIS OF CYCLONES MODIFICATION

## INVESTMENT

Cost of Cyclone-4 modification - Rs. 11.26 Lakhs

Cost of Cyclone-3 modification - Rs 11.55 Lakhs

Total cost of modification - Rs. 22 .81 Lakhs

## SAVINGS

### THERMAL

Specific heat consumption reduction after Cyclone-4 modification - 13.7 kcal/Kg cl

Specific heat consumption reduction after Cyclone-3 modification - 12.8 kcal/Kg cl

Total annual monetary savings - Rs.23.7 Lakhs/yr.

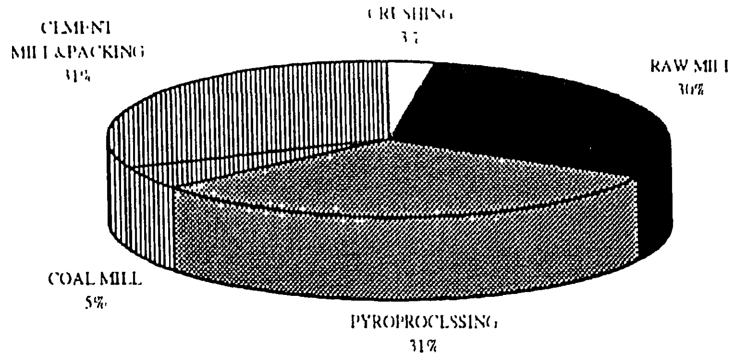
### ELECTRICAL

Sp. power consumption reduction - 1 kWh/t of cl

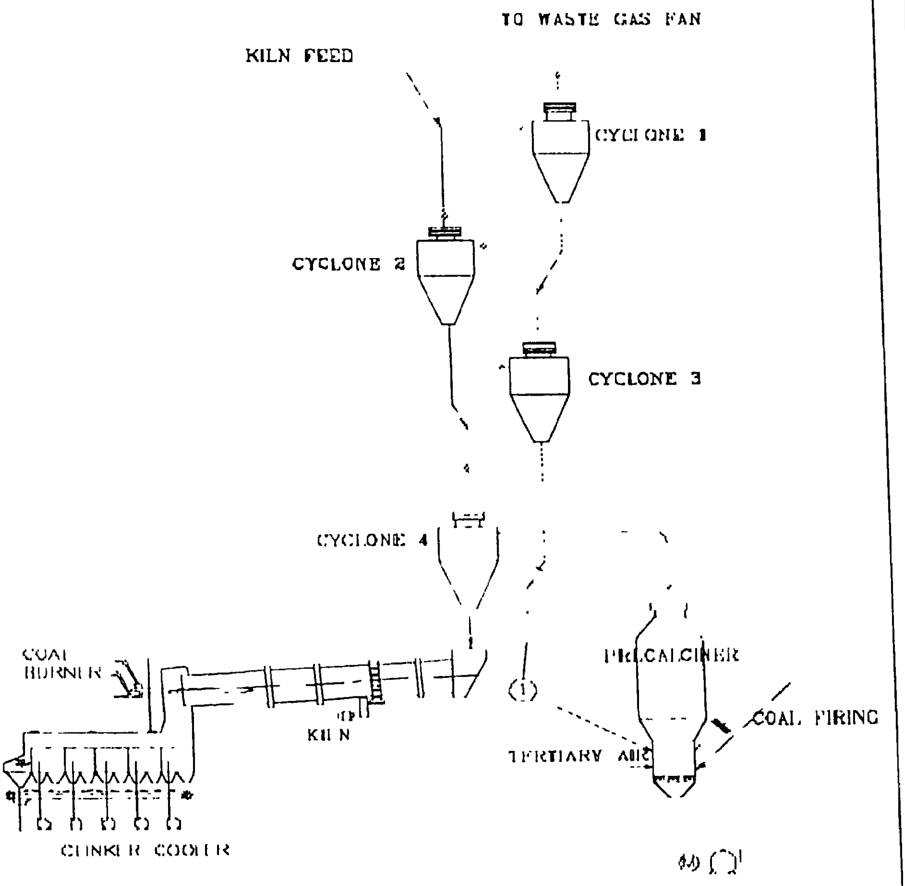
Annual monetary savings - Rs. 11.0 Lakhs/yr

Total Savings ( Excluding the benefits from increased clinker production) - Rs 34.7 Lakhs/yr.

% SHARE OF PROCESS ELEC ENERGY CONSUMPTION FIG-1



PYROPROCESSING SYSTEM FIG-2



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# Programme on Energy, Environment, Resources, and Sustainability (PEERS) - 1997/98

## Final Project Report

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# ammonia and urea fertilizer plants - energy and environmental issues and strategies for improvements

*Submitted by*

**Mr S G Choudhary**

# PEERS 97-98

Project Report: "**Ammonia and Urea Fertilizer Plants-Energy and Environmental Issues and Strategies for Improvements**"

Presented by: **S.G. Choudhary**
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## EXECUTIVE SUMMARY

More than 90 % of the human diet consist of directly consumed plant products. If per capita food intake were to remain constant, 8.3 billion people in 2025 would require about 7 billion gross tons of food. Presently more than 1.1 billion people have marginal diets. About 0.4 billion people suffer from Chronic nutritional deficiencies. If their diets were also improved to adequate levels, annual food production would need to double to 9.2 billion tons by 2025, a steady increase of 2 to 2.5 percent per year.

Achieving high, efficient production in food supply, a condition necessary for Food Security, and meeting growing food needs are the challenges for the world in the coming future.

Use of chemical fertilizers to increase the productivity of arable land is unavoidable. Organic recycling can supplement about 20-30% of nutrient demand. Biotechnology is beginning to provide answers but has long way to go.

The sustainability will demand use of organic manure as well as balanced use of synthetic fertilizers. The manufacture of chemical fertilizers like ammonia and urea are highly energy intensive and potentially polluting and risk associated processes. The large-scale manufacture of synthetic fertilizers demands exploitation of energy and natural resources and have environmental impact. In an endeavour towards sustainable agriculture it shall be necessary to look at the most environmentally friendly way to produce fertilizers such as ammonia and urea.

The study presented in this report brings out these issues. Using the performance data of the energy and environmentally efficient operation of the Ammonia and Urea fertilizer complex of Tata Chemicals Limited at Babrala in Dist Badaun of U.P., India, strategies are proposed to improve further the energy efficiency and reduce the water demand and effluent generation.

FOOD SECURITY

CLEANER WORLD

ENRICH ENVIRONMENT

# PROJECT REPORT

# AMMONIA AND UREA PLANT - ENERGY AND ENVIRONMENTAL ISSUES AND STRATEGIES FOR IMPROVEMENTS

**S.G. CHOUDHARY**
TATA CHEMICALS LIMITED
BABRALA, INDIA

AS PART OF

**PEERS 97-98 PROGRAMME**
(TATA ENERGY RESEARCH INSTITUTE, NEW DELHI)

**FERTILISER FOR FOOD SECURITY**

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The organisation of the programme by TERI, New Delhi and the sponsoring institutions from Canada, Norway and by TERI, USA was excellent and effective.

I am submitting the project report prepared as part of the programme and thank Mr. Somnath Bhattacharya and Mr. N. Vasudevan for providing guidance in finalising the report.

Choudhary

(S.G. Choudhary)

## CONTENTS

| S.NO | TITLE | PAGE |
|---|---|---|
| 1 | INTRODUCTION | 1 |
| 2 | FOCUS OF PROJECT REPORT | 3 |
| 3 | AMMONIA PRODUCTION PROCESSES | 3 |
| 4 | INPUTS, OUTPUTS AND EMISSION LEVELS IN AMMONIA PROCESS | 8 |
| 5 | UREA PRODUCTION PROCESSES | 9 |
| 6 | INPUTS, OUTPUTS AND EMISSION LEVELS IN UREA PROCESS | 11 |
| 7 | FEEDSTOCK FOR AMMONIA PLANT | 12 |
| 8 | ENERGY CONSUMPTION AND TECHNOLOGICAL OPTIONS | 13 |
| 9 | ENVIRONMENTAL ISSUES IN AMMONIA AND UREA PLANT | 15 |
| 10 | BABRALA FERTILISER COMPLEX-ENERGY AND ENVIRONMENTAL CONSIDERATIONS | 16 |
| 11 | AREAS FOR IMPROVEMENTS | 19 |
| 12 | PROPOSED STRATEGIES FOR REDUCTION IN ENERGY USE | 19 |
| 13 | RESULTS IN PUBLISHED CASE STUDY OF ENERGY ANALYSIS IN SIMILAR PLANT IN CANADA | 24 |
| 14 | WASTEWATER MINIMISATION IN WATER DEMINERALISATION PLANT | 30 |
| 15 | ENVIRONMENTAL ISSUES IN MICROBIAL CONTROL IN COOLING WATER - STRATEGIES FOR IMPROVEMENT | 32 |

### ANNEXURES

I WORLD FERTILISER PRODUCTION, POPULATION PROJECTION AND CROP YIELDS
II TYPICAL INPUT, OUTPUT AND EMISSIONS IN AMMONIA PLANT
III TYPICAL INPUTS IN UREA PLANT
IV DEMAND AND SUPPLY OF NAPHTHA AND FUEL OIL AND NATURAL GAS
V ENERGY CONSUMPTION AND TYPE OF FEEDSTOCK, FEEDSTOCK AND CAPITAL INVESTMENT, CAPACITY OF 'N' AS PER FEEDSTOCK
VI ECO-EFFCIENCY TARGETS AND ACHIEVEMENTS AT BABRALA FERTILISER COMPLEX
VII EXERGY LOSSES IN AMMONIA PLANT AND UREA PLAMT

### FIGURES

1 LOCATION OF BABRALA FERTILISER COMPLEX
2 N, P, K FERTILISER PRODUCTION ROUTES
3 PLANT OVERVIEW
4 PROCESS FLOW DIAGRAM OF AMMONIA AND UREA PLANT
5 PROCESSES AND EMISSIONS IN THE PLANT
6 CONSEQUENCE OF PRODUCTION AND USE OF UREA
7 OPTIONS OF WATER DEMINERALISATION
8 COOLING TOWER OZONATION

# AMMONIA / UREA FERTILIZER PLANTS- ENERGY AND ENVIRONMENTAL ISSUES AND STRATEGIES FOR IMPROVEMENTS

## INTRODUCTION

## FOOD SECURITY AND FERTILIZER USE

Food is fundamental to human survival. In the early 1800's, Professor Malthus, the noted British statistician, warned that the inability to feed itself would ultimately limit human population growth, with devastating consequences. He postulated that mankind could only expand food production at an arithmetic rate while population could and indeed would eventually overrun its land resource base.

The fertilizer industry was born from a conjunction of following circumstances which originated in North Western Europe in the late part of the 18th, and the first half of the 19th centuries and are applicable to many of the developing countries.

- a revolutionary new concept of plant nutrition, supported by pioneering experimentation, which discovered the biological role of chemical elements;
- an industrial revolution, which stimulated technological innovation and the growth of chemical, mining and transportation industries, thus providing the infant fertilizer industry with increasingly economic source of raw materials and access to potential markets;
- growing population densities and rapid urbanization, which created concentrated off-farm markets for food and fiber and a growing need to restore soil nutrient, to increase or maintain crop yields and reduce dependence on agricultural imports;
- hence, increasingly heavy, laborious manuring and cultivation, which, by the mid-19th century, were approaching their economic and physical limits.

World food production in 1990 was about 4.6 billion tons. More than 90 % of the human diet consist of directly consumed plant products. If per capita food intake were to remain constant, 8.3 billion people in 2025 would require an additional 2.6 billion gross tons of food, almost a 60 percent increase. Still more than 1.1 billion people have marginal diets. If their diets were also improved to adequate levels, annual food production would need to double to 9.2 billion tons, a steady increase to 2 to 2.5 percent per year.

The Food and Agricultural Organization (FAO) of UN have estimated that only 24 percent of future food needs can be produced on new land. The remaining 76 percent must come from increased crop yields on currently farmed lands. This also means that average yield per hectare must increase at least 65 percent.

Balanced and adequate fertilization are keys to increasing food production by enhancing land productivity. Higher productivity is essential because of competition for arable land as countries continue to industrialize and as population increases. No country in the world, developed or developing, has been able to increase agricultural production without expanding the use of fertilizers. In fact, in countries where consumption of plant nutrients from fertilizer and manure is low, agricultural production is also low and or yields are stagnant or declining.

At the global level, the relationship between fertilizer use and cereal production reveals the close association between fertilizer consumption and crop production. It is estimated that about 50 percent of the increase in agricultural production in the US has been due to the use of fertilizers.

In China 30-50 percent of the total crop production increase in recent years has been attributed to the use of mineral fertilizers. At present China is the largest importer of fertilizers.

India is the world's third largest fertilizer user. In the early 1980's fertilizers were estimated to be responsible for 35-40 percent of total foodgrain output. An even higher contribution of 50 percent is anticipated by the end of this century. One of the major factors that contributed to achieve spectacular increase in food grain production in India over the last few decades leading to self sufficiency is the chemical fertilizer nutrient as agricultural inputs.

**Annexure-I** gives world fertilizer production by region and major nutrients and the world population projection and the crop yields.

In India the average consumption of fertilizer nutrients has increased from less than 1 kg/hectare in 1951-52 to about 74 kg/hectare in 1994-95 and simultaneously the food production increased from 52 million tons in 1951-52 to 191 million tons in 1994-95. The consequent increase in the demand and consumption of fertilizers has been substantially met by supplies from the indigenous fertilizer industry which made rapid strides during the 80's. This was possible due to the farmer and industry friendly policy of the Government and availability of indigenous raw materials.

The demand is still on the rise, and by the end of 9th plan(2001-2002) the requirement of "N" nutrient alone is estimated to be 13.4 million tons (MMT) under price correction scenario and 17.88 MMT without the price correction as per the 9th plan document prepared by the fertilizer ministry. The Government policy in the fertilizer sector has been to achieve maximum degree of self sufficiency in nitrogen production utilizing indigenous feedstock leaving only marginal quantities to import for balancing demand supply variations.

Presently in India, there are 41 plants producing straight nitrogen(N) fertilizers with an installed capacity of 8.5 MMT of nitrogen, while 17 NP/NPK complex fertilizer plants contribute together produced a total of 8.775 MMT of nitrogen during 1995-96, of the total nitrogen produced 7.566 MMT was from straight 'N' producing plants.If projects which are under various stages of construction are taken into consideration the installed capacity shall increase to 11.475 MMT. The production routes for various N, P, K based fertilizers is shown in **Figure 2**.

Amongst the straight nitrogenous fertilizers, urea which is manufactured from ammonia is the most popular among the farmers due to

(1) being the cheapest source of Nitrogen,
(2) its application leaves the soil chemically neutral,
(3) cost of transportation and handling is low in terms of 'N' nutrient and
(4) is suitable for multiple cropping pattern in diverse agroclimatic conditions.

The contributions of urea to total nitrogen production (inclusive of 'N' available for complex fertilizers) in the country is at present 82.9%. Among the straight nitrogen fertilizers urea's contribution is 96.2% in 1995-96.

The goal of sustainable agriculture should be to maintain production at levels necessary to meet the increasing aspirations of an expanding world population without degrading the environment.

## FOCUS OF PROJECT REPORT

The main focus of this study report is to look at the technologies for reduction in use of energy in the manufacture of ammonia and urea and the new methods of further abating the adverse impact on environment by reduction in wastewater from utility plants in the manufacturing of ammonia and urea fertilizer. The use of fertilizer leads to increase in agriculture which leads to consumption of CO2 from the atmosphere. The way to produce ammonia and urea fertilizer with lowest emissions of CO2 and other gases like NOx, SOx, HC etc. and reduced energy demand and associated liquid and solid discharges will significantly contribute to sustainable use of synthetic fertilizers and reduce the cost of production.

## AMMONIA PRODUCTION PROCESSES

More than 90 % of world nitrogen fertilizer production is based on ammonia (NH3). Ammonia is basically produced from water, air and energy. The source of energy is normally hydrocarbons, but may also be coal or electricity. Natural gas is generally the preferred hydrocarbon :some 77% of world ammonia production capacity is currently based on natural gas.

A modern ammonia plant has a typical capacity of 1500-1800 t/d, although new plants are now being constructed up to 2000 t/d. The process and energy systems are integrated to maximize energy efficiency, but surplus steam and/or energy, together with by-product carbon dioxide(CO2) may be exported. However, ammonia plants are commonly integrated with other plants, particularly with urea plants which make use of the CO2. Ammonia plant battery limit generally include

- feedstock and fuel supply by pipelines at sufficient pressure for reforming.
- untreated water and air,
- ammonia product stored as liquid, either refrigerated at atmospheric pressure or non-refrigerated at ambient temperature.

Three main types of process are currently used for ammonia production:

- steam reforming of natural gas or other light hydrocarbons (natural gas liquids, liquefied petroleum gas, naphtha),
- partial oxidation of heavy fuel oil or vacuum residue,
- coal gasification.

### PROCESSES

### Steam reforming of Natural Gas

About 85% of world ammonia production is based on steam reforming concepts The approximate formulae for ammonia synthesis from natural gas are as follows:

1 $0.88CH_4 + 1.26air + 1.24H_2O \Rightarrow 0.88CO_2 + N_2 + 3H_2$

2 $N_2 + 3H_2 \Rightarrow 2NH_3$

The first reaction, producing synthesis gas, normally takes place at 25-35 bar pressure, while the ammonia synthesis pressure ranges from 140-250 bar.

Natural gas contains sulfur compounds which would poison most of the process catalysts. Consequently, these compounds are initially removed from the feed-gas by heating to 350-400 deg.c. and then hydrogenating the sulfur compounds to $H_2S$ in a desulfurisatiion vessel, typically using a cobalt molybdenum catalyst. The $H_2S$ is adsorbed on palletized zinc oxide, forming zinc sulfide. The hydrogen is normally provided by the synthesis section, and the zinc sulfide remains in the adsorption bed. The resulting gas feed contains less than 0.1 PPM sulfur and is then mixed with steam. This mixture is heated to 500-600 deg.c. and introduced to the primary reformer ( or in some cases to an adiabatic prereformer preceding the primary reformer).

The heat for the primary reforming process is supplied by burning gas in a radiant box containing the process tubes. The amount of sulfur in natural gas is usually small enough to avoid the need for desulphurisation of the fuel gas, but if this is necessary to meet local emission standards, the plant's entire gas supply is desulphurised, using wet process.

The flue gas leaving the radiant box has a temperature of more than 900 deg.c. Only 50-60% of the fuel's heat value is directly used in the process itself, but the heat of the flue gas is used in the reformer convection section, for steam generation and other process requirements. In the usual reforming process, the consumption of fuel-gas energy is 40-50 % of that of feed-gas energy. The flue gas leaves the convection section at 100-200 deg.c. and is the main source of emission from the plant. They contain mainly $CO_2$ and $NO_x$ with small amounts of $SO_2$ and CO.

Only 30-40% of the feed-gas is reformed in the primary reformer. To increase the conversion, the temperature is raised in a secondary reformer by internal combustion of part of the gas with the process air. Since the latter also provides the nitrogen for the synthesis gas, the extent of primary reforming is adjusted so that the air supplied to the secondary reformer meets both the heat balance and the stoichiometric synthesis gas requirement. The gas/air mixture is then passed over a nickel-containing catalyst which effects the remainder of the conversion: on emerging from the secondary reformer at a temperature of around 1000 deg.c., about 99% of the original feed-gas has been converted. The process gas is then cooled to 350-400 deg.c. in a waste heat steam boiler/superheater.

The process gas contains 12-15% CO (dry gas basis). Most of this CO is converted to $CO_2$, firstly by passing the process gas through a bed of iron oxide/chromium oxide catalyst at around 400 deg.c. and then over a copper oxide catalyst at about 200-220 deg.c. The residual CO content of the gas is 0.2-0.4%. At this point, the gas consists mainly of $H_2$, $N_2$, $CO_2$ and the excess process steam. he condensate normally contains 1500-2000 PPM of ammonia and 800-1200 PPM of methanol, as well as some $CO_2$ and catalyst metals. These impurities should be stripped out and/or recycled.

In older plants, the process condensate is treated simply in a column into which low-pressure steam is fed in at the bottom. A mixture of steam and gases is vented to the atmosphere, while the stripped condensate is cooled and discharged as effluent.

Although this reduces the ammonia content of the condensate, it does not solve the environmental problem of the effluents and emissions. Two main solutions are available:

- use of ion-exchange resins, passing the condensate through a strongly acid cation exchanger and then through a weakly basic anion-exchanger, and possibly through a mixed bed. This can enable reuse of the condensate as boiler feed water;
- use of condensate for natural gas saturation, thus reducing steam consumption and avoiding the need to treat the condensate. However, this requires special equipment and additional circuitry.

Since ammonia plants are usually associated with nitrogen fertilizer plants, the ammonia process condensate can be mixed with the waste water of the fertilizer plants and treated for the recovery of useful substances. Nitric acid can be used to regenerate ion-exchange resins, and this can result in 20-28% ammonium nitrate solutions.

After the CO-CO2 shift conversion, the process gas usually contains about 18 % CO2 which is then removed in a chemical or physical absorption process. The solvents used in chemical processes are mainly aqueous amine solutions or hot carbonate solutions. Physical solvents include glycol dimethylethers and propylene carbonate.

Absorption is followed by desorption through a pressure decrease and temperature increase. The resulting CO2 (1.3-1.4 t per t of NH3) is used for the manufacture of urea, dry ice, or in other applications.

At this point, only small amounts of CO and CO2 still remain in the synthesis gas, but they must be removed, because they would poison the ammonia synthesis catalyst. This removal is achieved by mixing the CO and CO2 with hydrogen and converting the mixture to methane(CH4) and water by passing through a reactor filled with a nickel-containing catalyst at a temperature of around 300 deg.c. The methane is an inert gas in the synthesis reaction, but the water must be removed; and this is achieved firstly by cooling and condensation and subsequently by condensation/absorption in the product ammonia.

The synthesis gas must then be compressed, since ammonia synthesis takes place under pressures which are normally in the range of 100-250 bar. Modern plants use centrifugal compressors, usually driven by steam turbines with the steam from the ammonia plant. The reaction uses an iron catalyst at temperatures of 350-550 deg.c. and is exothermic. Consequently, extensive heat exchange is required. Moreover, only 20-30% of the synthesis gas is converted with each pass through the converter, thus necessitating a loop arrangement, with the ammonia being separated off by cooling/condensation and fresh synthesis gas making up the difference in the loop. Inert gases left in the synthesis gas are taken out in a purge stream which is designed to leave the level in the loop at about 10-15 %. The purge gas is scrubbed with water to remove ammonia and is then used as fuel or sent for hydrogen recovery.

The cooling and condensation of the product ammonia is achieved in a refrigeration compressor, which is normally driven by a steam turbine. If cooling is with water or air, condensation is largely incomplete. Consequently, vaporized ammonia is used as a refrigerant in most plants, in order to achieve satisfactory low ammonia concentrations in the gas recycled to the converter.

The liquefied product ammonia is either used directly in downstream plants or stored in tanks. These tanks are of three types:

- fully refrigerated, with a typical capacity of 10000-30000 t,
- pressurized storage spheres up to about 1700 t,
- semi refrigerated tanks.

**Various energy saving measure being adopted in new grass root ammonia plants are listed below:**

- High pressure steam superheater in the exit of reformed gas boiler instead of externally fired unit.
- Superior material for primary reformer catalyst tubes like the 25 Cr - 35 Ni, Nb, Ti (Mannurite XM alloy) which reduces the tube wall temperature an leads to lesser fuel input and heat loss in flue gas.
- Gas turbine driven air compressor for Process air.
- Stripping of Process Condensate with medium pressure steam.
- Low energy CO2 removal processes.
- Purge gas recovery unit.
- Heat Recovery from stripped process condensate for BFW heating.
- Use of adiabatic preconverter.
- Installation of makeup gas chiller at suction of Syn Gas compressor.
- Use of molecular sieves for purification of make up gas syn gas to remove H2O and CO2.
- Additional volumes of LT shift conversion catalyst.
- Improvement in syn converter systems.

Steam reforming ammonia processes offer sufficient waste heat for steam production and electricity, but usually it is convenient to export small amounts of steam and import electricity.

**Future developments are expected to increase efficiency and decrease emissions by:**

- lowering the steam to carbon ratio,
- increasing the conversion share of the secondary reformer,
- improving the purification of synthesis gas,
- increasing the efficiency of the synthesis loop,
- improving the power energy system.
- high activity Ammonia Synthesis Catalyst
- advance instrumentation and dynamic multivariable control system.
- improvements in process gas compressors and steam turbine efficiencies.

Recent improvements tending in these directions include:

- excess air steam reforming,
- heat exchange autothermal reforming.
- multivariable control system

### Excess Air Secondary Reforming

The low marginal efficiency of the primary reformer has prompted the design of processes which shift more of the reaction on the secondary reformer. These processes feature:

- Decreased firing in the primary reformer, lowering the outlet temperature to about 700 deg.c.. This increases the firing efficiency, reduces the size and cost of the primary reformer, and prolongs the life of the catalyst, the catalyst tube and the outlet header;
- Increased process air supply to the secondary reformer. This increases the internal firing to achieve the same degree of total reforming. It also necessitates compression capacity.
- Cryogenic final purification. This removes all the methane and excess nitrogen from the synthesis gas , as well as some argon. With almost no impurities in the synthesis gas, higher ammonia conversion rates can be achieved with a lower purge flow. Since cooling is produced by depressurisation, no external coolant is needed. The net result is a significantly more efficient process.

## Heat Exchange Autothermal Reforming

Reformer exit gases are at such high levels that it is thermodynamically wasteful to use them solely to raise steam. This heat can be recycled to the process itself by using the heat content of the secondary reformed gas in a primary reformer based on heat exchange, thus eliminating the fired furnace. In this case, surplus air, or oxygen-enriched air , is needed in the secondary reformer to meet the heat balance requirements. The elimination of flue gas from the primary reformer obviously reduces atmospheric emissions. For example, compared to conventional steam reforming, NOx emissions may be reduced by 50% or more.

The CO is converted to CO2 by passing through two high temperature catalyst beds with intermediate cooling. The CO2 is then removed by an absorption agent ,which could be the same as in the sulfur removal. After this, residual traces of the absorption agent and CO2 are removed, before final purification of the gas by a liquid nitrogen wash. This results in a virtually pure synthesis gas, to which some nitrogen is added to provide the stoichiometric H/N ratio for ammonia. This avoids the need for purge in the ammonia synthesis loop and improves its efficiency, compared with the steam reforming process. On the other hand, auxiliary boilers are needed, if the compressors are steam driven, and boiler fuels result in emissions of SO2, NOx and CO2, unless electricity is used.

In the case of coal gasification, the main stages include coal grinding and preparation of slurry for pulverization, in addition to those in the heavy fuel oil process. The principal effluents from the latter are waste water, H2S, CO2, CO, N2, and small amounts of tail gas from the ammonia synthesis. In the case of coal gasificaton, coal slags must be added to this list.

## Multivariable Control System

The multivariable control system uses a set of reduced equations derived from well known steady-state process simulators. A "core" model is achieved by matching simulation results closely to actual plant operating data. The reduced equations that predict rigorous simulation results are compared with plant dynamics and operating constraints derived from plant tests to form a module. Each module is application specific to the particular process type and customised as necessory for the idiosyncrasies of the particular operation. The modules are then integrated with the multivariable controller, economic optimiser and a set of generic tools to yield the system. This approach produces a solution that allows multiple plant operating objectives in an economic optimum manner. Several objectives of primary reformer operation justify multivariable control (MVC) such as:

- provide smoother plant operation.
- reduce operator intervention from application of closed loop supervisory control.
- minimise constraint violations with better safety guarantees.
- reduce Kcal/Mt energy consumption.
- increase through puts.
- provide better process performance information.

The multivariable control are designed to meet these objectives and the operators readily accept the concepts. This system handles many routine assignments while making up to 2000 incremental setpoint changes per hour. These small setpoint changes are in contrast to an operator's normal action, 5-10 setpoint changes per hour. The project payouts for installation of such control system in an operating plant is of the order of six months.

## INPUTS, OUTPUTS AND EMISSION LEVELS IN AMMONIA PROCESS

Typical production inputs, outputs and atmospheric emission levels for modern ammonia plants, based on Best Available Technology(BAT), are shown in the **Annexure-II**. These figures are purely indicative: they are not intended to be comprehensive, and circumstances can vary considerably. The use of by-product $CO_2$, for example, reduces the total $CO_2$ emissions very considerably, but this depends entirely on the needs of downstream facilities. Fugitive emissions of light hydrocarbons, hydrogen, $NH_3$, CO and $CO_2$ can occur due to leaks from flanges, stuffing boxes, maintenance work, and catalyst handling. Moreover, temporary situations, such as plant start-up, involve the flaring of synthesis gas, and in this case NOx emissions may amount to an additional 10-20 kg/hr. Obviously, much depends on standards of operation and maintenance, as well as on the process and raw materials used.

We have not included sulfur as an output. As indicated above, sulfur compounds are present in very small quantities in natural gas (up to 5 mg S/Nm3) and are almost entirely recovered from the feed gas by a zinc oxide adsorber. In steam reforming, sulfur emissions from the fuel gas are almost negligible. However, larger amounts of sulfur are present in heavy oils and coal. Partial oxidation processes extract up to 95% of this in a Claus sulfur recovery unit. Even so, the amount of sulfur emissions in this case is much more than in the case of natural gas. Depending on recovery equipment, up to 3 kg $SO_2$/t $NH_3$ could be emitted from coal and fuel oil based plants, compared with around 0 2 kg in gas based plants.

The data clearly indicates the superiority of steam reforming over partial oxidation processes, both with regard to inputs and emissions. Its also shows the wide range of achievable performances. Excess air reforming and autothermal reforming provide significant reductions in emissions, and autothermal reforming can also reduce total energy consumption by necessitating (increased) power importation and decreasing net heat loss. Energy consumption has decreased continuously in new plants over the last 25 years, and the optimal energy consumption of new plants may soon be 27-29 GJ/t $NH_3$, the theoretical minimum being 25 GJ(HHV)

Without treatment, emissions to water can arise from process condensates of waste gas scrubbing. Condensates arise mainly from cooling the process gas prior to CO2 removal. About 1 m3 condensate/t NH3 is produced, containing upto 1 kg NH3 and 1 kg methanol (CH3OH). About 95% of these substances can be recovered and recycled by stripping with process steam. The stripped condensate can be further purified by ion exchange and then reused as boiler feed water. Similarly, ammonia from the purge and flash gases can be recovered in a closed loop. Thus, emissions to water can be almost fully avoided, although , in the partial oxidation process, traces of soot and coal slag occur.

BAT ammonia processes do not normally produce solid wastes. Spent catalysts and molecular sieves are removed, and their valuable metals are recovered ; and, as indicated above, solid sulfur is recovered in partial oxidation processes.

The economically achievable minimum levels vary between new and existing plants. Assuming steady state production, NOx can be limited to 0.45 kg NO2 /t NH3 (75 ppmv or 150 mg/Nm3) in new plants and about twice this in existing plants. Total energy consumption can be reduced to 0.1 kg/t NH3 produced. Spent catalysts can be limited to about 0.2 kg/t NH3. Environmental investment and operating costs are obviously variable from plant to plant , according to emission standards or targets, process design, integration with other facilities, raw materials, revamping requirements, etc.

## UREA PRODUCTION PROCESSES

Urea accounts for almost 50% of world nitrogen fertilizer production (in terms of N content, and including multinutrient products), compared with only 30% a decade previously. It is produced by combining ammonia and carbon dioxide at high pressure (140-200 bar) and high temperature (180-190 deg.c.) to form ammonium carbamate, which is then dehydrated by heat to form urea and water, according to the following reactions

$$2\ NH_3 + CO_2 \Rightarrow NH_2COONH_4 \Rightarrow CO(NH_2)_2 + H_2O$$

The first stage of the reaction is exothermic and proceeds to virtual completion under industrial conditions. The second stage is endothermic, and conversion is only partial (50-80%, CO2 basis). The conversion is increased by increasing the temperature, increasing the NH3/CO2 ratio and/or decreasing the H2O/CO2 ratio. Process design is mainly concerned with the most efficient ways to separate product urea from the other reaction components, to recover excess NH3, and to decompose the residual carbamate to NH3 and CO2 recycling.

There are three main type of processes:

- once through process: unconverted CO2 and NH3 are discharged to other plants, where the NH3 is used for the production of fertilizers such as ammonium sulfate and ammonium nitrate;
- Partial recycle process: unconverted CO2 and NH3 are partially separated in the decomposition section of the first stage and are then recovered in and absorber, the remainder being delivered to other plants as in the once through process;
- Total recycle process: unconverted CO2 and NH3 are totally separated in multi-stage decomposers recovered in corresponding multi-stage absorbers, and recycled to the reactor.

If the residual $NH_3$ and $CO_2$ cannot be used in downstream plants, a total recycle process is necessary. In early urea technology, this was achieved in a series of loops with decreasing pressure, which cooled, condensed and recombined the gases to form carbamate liquor, which was then recycled to the synthesis section. This increased the $NH_3/CO_2$ ratio, and hence the yield of urea. Better than this, however, processes were developed which decompose the carbamate in the reactor effluent without reducing the system pressure. This requires a "stripping" gas, which can be either $CO_2$ or $NH_3$, or both.

Carbon Dioxide Stripping

If $CO_2$ is used as the stripping agent, urea conversion occurs at about 140 bar and 180-185 deg.c., with a molar $NH_3/CO_2$ ratio of 2.95. This gives a conversion of about 60% $CO_2$ and 41 % $NH_3$. At or about system pressure, $CO_2$ is added to the reactor effluent, and the stripped $NH_3$ and $CO_2$ are then partially condensed and recycled. Resultant heat is used to produce steam, some of which provides heat for the downstream sections of the process, and some goes to drive the turbine of the $CO_2$ compressor. $NH_3$ and $CO_2$ in the stripper effluent are fist vaporized and then condensed to carbamate solution, which is recycled. The process urea solution is further concentrated in an evaporation section; producing a melt of 99.7% urea, which is then prilled or granulated.

Ammonia Stripping

If $NH_3$ is used for carbamate stripping, the pressure and $NH_3/CO_2$ ratio is somewhat higher in the synthesis section, giving a $CO_2$ conversion rate of 65%. Excess $NH_3$ is introduced to the reactor effluent, decomposing a large part of the unconverted carbamate. Residual carbamate and $CO_2$ are then recovered in a two stage. Gas vapours from the top of the stripper are mixed with the recovered carbamate solution, condensed and recycle to the reactor. Resultant heat is used to produce steam. The urea solution is evaporated to a melt, and then prilled or granulated.

Advanced Cost and Energy Saving (ACES) Process

The so-called ACES process is essentially a $CO_2$ stripping process which operate at somewhat higher pressure (175 bar) and $NH_3/CO_2$ ratio , as will as a slightly higher temperature, compared with the conventional process. Stripper gases are passed into two parallel carbamate condensers. Steam is generated for downstream heating, and the carbamate solution and non-condensed gaseous mixture are recycled to the reactor. The urea solution passes through a vacuum concentrator and is then further evaporated to about 99% urea melt

Isobaric Double Recycle (IDR) Process

This process uses both $CO_2$ and $NH_3$ as stripping agents. Operating at 200 bar and 185-190 deg.c., with an $NH_3/CO_2$ ratio of 4.5, a $CO_2$ conversion rate of 71% is obtained, with 35% for $NH_3$. The reactor effluent then passes into a first stripper, which uses $NH_3$, and then remaining $NH_3$ is then separated in a second stripper, using $CO_2$. Gases from the first stripper go directly to the reactor, and those from the second stripper pass first through the carbamate condenser. Two vacuum evaporators concentrate the urea solution to a melt for prilling or granulation.

Prilling is achieved by conveying the urea melt to the top of a tall tower and spraying it down the tower through an up-draft of air, which can be either natural or forced. As it falls, the liquid droplets solidify to prills with diameters of 1.6-2.0 mm. Granulation is achieved by spraying the melt on to recycled seed particles or prills rotating in the granulator. Granules grow larger, and the product is simultaneously solidified and dried. Traditional granulation processes involve recycling, the ratio of recycled to final product varying between 0.5-1.0. However, prill granulation has a very small recycle ratio, typically 2-4%.

## INPUTS, OUTPUTS AND EMISSION LEVELS IN UREA PROCESSES

Typical inputs into modern urea plants are given in the **Annexure-III**, although it should be noted that actual figures can vary considerably. Urea plant sizes are normally commensurate with the amounts of NH3 and CO2 available from associated ammonia plants. A typical output in a new BAT plant is 1500 t/d of urea. Water outputs include the process condensate ( upto 0.5 t/t urea) and the steam and/or turbine condensate (0.4 and 0.2 t/t urea respectively). They are normally treated and reused as boiler feed. Low pressure steam may be used for process heating, or in turbines, or exported for other activities.

Atmospheric emissions are mainly NH3 and urea dust. Both arise from the prilling or granulation process. The ammonia results from the degradation of ammonia to form biuret in the prilling tower. Much of the dust from prilling towers and granulators is caused by condensation products of urea vapors. Some is due to the presence of isocynic acid(HCNO) and its reaction with NH3, to form urea. The remainder arises from seeding dust, undersize prills or granules, mini-prills, broken-down prills and attrition. Prilling towers with natural up-draft may have less attrition and, hence, less dust than those with forced up-draft. From the prilling tower, emissions should range from 0.5 to 1 kg NH3/t and 0.5 - 1.5 kg urea dust/t. With granulation, the granulator exit gas is scrubbed and losses can thereby limited to 0.25-0.8 kg NH3/t and 0.25-0.4 kg urea dust/t. In both cases, the lower figures existing plants exceed these levels. It should also be noted that, without scrubbing, dust emission from granulators would be in the range of 5 to 30 kg/t or more, depending on granulation efficiency.

Explosive mixture have been a serious problem for urea plants.. In some cases serious explosions have resulted in loss of life. Explsosive mixtures are due to the simultaneous presence of combustible compounds (CH4, C2H2, CO, H2) introduced into the plant with the fresh NH3 and CO2 and the presence of NH3 and O2 that enters with passivation air when all these so called 'inerts' are released from the plant to the atmosphere, they have compositions that are of an explosive nature.

Liquid emissions relate mainly to NH3, CO2 and urea in the process water, which is generated by the reaction at about 0.5 m3/t urea. This normally contains some NH3, 4% CO2, and 1% urea (by weight) and must therefore be treated. The recovered gases are recycled to the synthesis, and, in a well managed BAT plant, emissions to water can be limited to 0.0025 kg NH3 and 0.0005 kg urea per ton of product. There are no solid wastes from urea plants, providing spillage is carefully collected.

## FEEDSTOCKS FOR AMMONIA PLANTS

During the early stage of the fertilizer industry in India, various feedstocks like coke, lignite, power, coke oven gas were utilised for the production of ammonia. The technological development centred on the use of light hydrocarbons and use of improved types of catalyst coupled with use of high pressure steam driven centrifugal compressor resulting in establishing a series fo naphtha based large capacity ammonia plants. Thus during 1960's and 1970's naphtha was the only feedstock available for all the ammonia plant based either on partial oxidation of naphtha in earlier stage or steam naphtha reformation later on. However, due to shortage of naphtha availability in domestic market and increased international price of naphtha, fuel oil based plants succeeded through partial oxidation process which can take up higher C/H ratio and sulfur. In the eighties with large find of offshore natural gas, large capacity of ammonia plant were built based on gas as feedstock. The HBJ gas pipeline helped carry the gas to various gas based fertilizer plant distributed in various location in the country.

In the present situation shortfall of natural gas, naphtha and fuel oil/LSHS for fertilizer sector and liberalization of economy and increasing trade in liquified natural gas(LNG) natural gas(regasified LNG) will be the preferred feedstock in India in near future.

From the report of the subgroup on refinery for the 9th plan the demand supply gap for naphtha and fuel oil/LSHS and from the report of working group on fertilizer for the 9th plan the demand of naphtha and fuel oil is shown in following table.

Of the total installed capacity of nitrogenous fertilizer plants in India which are under production at present, 51.2% are based on natural gas as feed stock, followed by 28.1% Naphtha, 13% fuel oil, 3.3% coal and 4.5% external imported ammonia.

The present annual consumption of the different feedstocks in the fertilizer sector in India are as given below:

| | | |
|---|---|---|
| 1) Natural Gas | : | 7.5 BCM |
| 2) Naphtha | : | 2.495 MMT |
| 3) Fuel Oil | : | 2 508 MMT |
| 4) Coal | : | 6 MMT |

Use of dual feed and fuel in Ammonia production

Due to the simplicity in plant operation, easy handling and availability of feedstocks, least specific energy consumption and capital cost, natural gas based ammonia plants contribute more than 75% of the world ammonia production. In the very recent past, specially for using natural gas, specially in power sector as also in other process industries, an unique situation has emerged, whereby, the large capacity gas based fertilizer units are facing shortage of supply of natural gas. The present as well as forthcoming plan outlay do not present a very encouraging scenario for the availability of natural gas till gas supply is augmented by new finds or supplies from gas rich countries through pipelines or LNG. **Annexure-IV** gives the demand and supply status of naphtha an fuel oil and natural gas in India.

Inadequate supply and shortage of natural gas is affecting the production performance of the gas based fertilizer plants. Many of the existing plants have switched over to dual feed and fuel system i.e. Natural Gas and Naphtha. However due to shortage of

Naphtha availability in domestic market, increased international price of Naphtha, fuel oil and LSHS and increasing trade in liquified natural gas on long term contract providing regasified LNG will make Natural Gas as the preferred and economical feedstock in India.

Various possibilities exist for using other feedstocks as supplement for the natural gas for ammonia production, under situations of constraints in natural gas supply. For the large capacity natural gas based failures plants in India, the choice of alternative feedstocks as supplement, shall be limited to lighter hydrocarbons, like naphtha, pentane, propane or LPG. India has 690 BCM of proved gas reserves, but levels of exploration, production and development have been low. in 1996-97, India produced 20.4 BCM of natural gas. This figure is expected by the Gas Authority of India Ltd(GAIL) to rise no higher than 30 BCM annually by 2003, and thereafter decline. Demand for gas continue expanding at a breakneck pace. India's gas demand gap, currently running at 26 BCM annually is forecast by GAIL to reach 78 BCM by 2000, and 120 BCM by 2005. LNG is proposed as solution to meet the shortages. However LNG can only be a stop-gap to cover medium term demand. Long term, it must secure pipeline supplies from Myanmar, Iran, and possibly even the Caspian Sea area. In the meantime, the fertilizer Industry, mostly fed from the Hazira-BIjaipur- Jagdishpur ) (HBJ) pipeline, continues to be subject to rationing and shortages.

## ENERGY CONSUMPTION AND TECHNOLOGICAL OPTIONS

A comprehensive survey of the historical development in Ammonia Production Technology reveals that the ammonia process flow sheet established about three decades ago, has remained basically unaltered till date. However, quite significantly, over the years there has been a phenomenal reduction in energy consumption per ton of ammonia. Needless to say, the quantum of energy saving, has always been the yardstick for assessment of technological upgradation. The main reason for achieving high level of energy efficiency and process reliability can be attributed to, (a) better understanding and application of catalyst science, (b) superior metallurgy for process equipments and machinery, (c) energy efficient decarbonation processes with improved variety of activators with synergistic effect and corrosion inhibitors and (d) systematic and rigorous application of thermo-dynamic principles for maximizing economic recovery of process waste heat and heat from flue gases and steam. A critical review of the technologies offered by the exponents of modern ammonia technology like M/S Haldor Topsoe, Brown & Roots, Kellogg, Uhde and ICI reveal their propensity to assimilate the aforesaid attributes to the maximum extent possible resulting in competitiveness in the economics of ammonia manufacture.

Energy consumption has become an environmental issue because of the ecological impact of energy production and transport, and because of the emission of greenhouse gases from fuel burning.

Fertilizer production currently accounts for about 2 -3 per cent of total global energy consumption. For Western Europe, the corresponding figure is about 1%. Nitrogen fertilizers account for a majority of this consumption. Most of the energy for fertilizer production is required by the fixation of atmospheric nitrogen to manufacture of ammonia. Energy is also required for the conversion of ammonia to liquid urea melt. Although fertilizer production will always consume large amounts of energy in processes requiring high temperature and pressures , the industry has become more energy efficient through improved design. Ammonia factories built in 1990 used some 30 percent less energy per ton of nitrogen than those designed around 1970. Present design is thermally very efficient and further energy saving beyond another 5 - 10 per cent is not feasible in ammonia production. Other potential nitrogen fixing methods (i.e. high temperature oxidation) are much less energy efficient.

Energy use in a new plant, using natural gas in a reforming process, including raw materials, can now be as low as 7.18 Gcal/mt NH3, compared with 18 Gcal/mt for the processes prevalent in the early 1960s. Partial oxidation processes use considerably more energy than reforming processes. In 1995, the average for all plants in the US fertilizer industry was about 9.6 Gcal/mt. In the case of urea, improved efficiencies achieved by modern total recycle plants halved the total energy input in the last 30 years to about 4.6 Gcal/mt (steam, electricity and cooling water).

The dependency on natural gas is a cause for long term concern. There is a potentially large economic and environmental cost in switching back to other, more polluting hydrocarbons (mainly coal), as and when gas resources are exhausted. Hydroelectric power can also be used, though this would require higher energy consumption and major rebuilding of the factories.

Several energy sources are used throughout the world as feedstock and fuels for ammonia production. Comparative consumption of the different energy sources per million mt of end product Ammonia are given in **Annexure-V**. As can be seen, the most efficient energy source is natural gas. In present day plants about 60% of the natural gas is used as feedstock and 40% as fuel. An IFDC study gave the relative capital investments for ammonia plants using different fuels a compared to using natural gas as feedstock which are shown in **Annexure-V**.

In the production of ammonia, the cost of natural gas represents a very large component. In the United States, the cost of the natural gas represents about 63% of the total production cost of ammonia ex-plant. The capital recovery costs are very low for existing U.S. plants. In a new plant, gas cost would probably be about 10-20% of the production cost. The high cost of natural gas in the production of ammonia has been decreased through technological innovations and through the increase in production efficiency. In India for the new plant the capital related costs are about 60% and natural gas represents 40% of the production costs.

The unit consumption decrease was very apparent until 1990. New plants are being designed for consumption of 7.2 to 7.8 Gcal/mt but in general plants are approaching the maximum economic decrease in energy consumption with the presently available technology in the USA. However, plants in some regions of the world have a much larger energy consumption. In India the new plants are adopting energy efficient technologies with the way being shown by Tata Fertilizer Complex- Babrala which has achieved energy consumption of 7.3 to 7.4 GCal/Mt ammonia. In the existing old plants retrofits are being used to improve the energy efficiency. Depending on the modification chosen, overall energy consumption reductions in the order of 15% can be achieved. At the same time, the adoption of specific retrofits usually allows an increase in plant capacity of up to 25% as compared to design. The costs of the retrofits are usually in the order of US $ 8 to $25 million. Prior to performing the modifications , feasibility and characterization studies need to be performed on the particular unit to help select the retrofits that will yield economically attractive results and determine the extent of the retrofits and their integration with rest of the plant. These studies will be also generate the information about the required investment costs for the different options considered. The pinch design method for the heat exchanger network and heat and power system studies and the exergy analysis studies are emerging as powerful analytical tools in evaluating various options.

## ENVIRONMENTAL ISSUES IN AMMONIA AND UREA PRODUCTION

Environmental issues concerning the fertilizer industry relate to the whole chain of production, storage , transport and use. In addition to the potential pollution of air, water and soil, there are hazards to be avoided in each section of this chain, as well as questions of occupational health and safety for all who handle these products. **Figure 6** depicts the consequence of production and use of urea as fertilizer.

While many of these issues are principally a local concern in the proximity of fertilizer plants several have a regional or even a global significance as for example release of air pollution and of greenhouse gases(GHG), mainly CO2. The global environmental problems are difficult to measure but the local environmental problems such as acid rain, water acidification, eutrofication and chemical mist can directly affect people, animals, vegetation and property in the vicinity of the plant.

In fertilizer production facilities are to achieve the lowest practicable environmental impact, both locally and globally, it is important that high standards of operation and maintenance be achieved. It is also necessary to monitor the emissions to air and discharges to water from the production plants, in order to enable the operators of the plant to take corrective action. Satisfactory technology now exists for the control of most potential pollutants resulting from fertilizer manufacture, and there is considerable progress with environmental management techniques.

### Greenhouse Gases(GHG)

The earth's atmosphere is largely transparent to visible light radiation which heats up the earth. The earth in turn radiates heat back to the atmosphere, but this is absorbed by water and many atmospheric gases and reemitted back to earth. Gases such as CO2, CH4, other hydrocarbons, NOx, halocarbons and O3 are all important in the process, to varying degrees, as a result of their physical characteristics and lifetime in the atmosphere.

global levels of these GHG's have increased significantly over this century, and significant temperature rises are hypothesized as a result. This may affect climatic patterns with consequent implications for ecosystems, agriculture and coastlines. Many national and international initiatives are now being implemented to to improve scientific understanding of climate change and to stabilize and eventually reduce emission levels.

The increasing atmospheric concentration of these gases is due to human, domestic and industrial activities. The increase appears to have started with industrialization, the intensification of agriculture and population growth, and became especially noticeable after the second world war.

The main concern is the increasing concentration of carbon dioxide (CO2). The annual net addition of CO2 to the atmosphere, resulting from human activities, has been estimated at about 8.5 billion tons of carbon, of which the share of the fertilizer industry is thought to be around 2%. Although the total anthropomorphic emissions are only about 7% of the quantity naturally released annually by biological processes, and despite the fact that most of the additional CO2 is released annually by biological processes, and despite the fact that most of the additional CO2 is absorbed by the oceans, there has been a significant increase in the CO2 content of surface air, the estimated average annual growth rate being in the range of 0.2 - 0.5%. In fact the use of fertilizer is for more crops and vegetation and in a small way contributes to capture and binding of CO2.

It is incumbent on all industries to keep CO2 emissions as low as possible, and the fertilizer industry contribute to this through technological progress in achievable energy efficiencies. The projected growth of fertilizer use makes such progress all the more necessary. But as technological progress nears its limits, further limitation of CO2 emissions must be mainly expected from the replacement of the old, inefficient plants by new ones. Although emitted in smaller quantities, certain other gases are more active than carbon dioxide in terms of global warming. Nitrous oxide (N2O) is 270 times as active as carbon dioxide. The ammonia removal and purge gas recovery unit in new plants like the one at TATACHEM, Babrala and the use of low NOx burners in the primary reformer and the Gas Turbines and steam generation units of the captive power plant and use of natural gas or naphtha as fuel have lowered the NOx emissions due to combustion.

## WATER AND EFFLUENT

The other area of environmental concern is the use of raw water in the manufacture to meet the demands of process, boiler, utility and cooling water. The systematic recycle of the process effluent and evolution of methods of reduction of wastewater from utility plant such as the water demineralization plant and cooling towers will go a long way in reducing the demand on already stretched water resources. Total recycle and zero effluent discharge concepts are being developed,

## BABRALA FERTILIZER COMPLEX

## ENERGY AND ENVIRONMENTAL CONSIDERATIONS

Tata Chemicals Limited (TATACHEM), founded in 1939, is a part of TATA group of companies. TATACHEM comprised of two divisions- Chemical Division located at Mithapur (West Coast, in Gujrat State) and the Fertilizer Division located at Babrala (Western Uttar Pradesh state). The location map of fertilizer complex is shown in **Figure:1** attached. The Chemical Division at Mithapur owns and operated a uniquely integrated inorganic chemical complex of TATACHEM is the largest not only in India, but in this part of the world and ranks among the most self reliant, energy efficient and water efficient operations anywhere in the world. TATACHEM had all along been in the forefront of development efforts towards sustainable production of basic chemical by continuous improvements in the eco-efficiency.

The fertilizer complex at Babrala comprises an ammonia plant having an installed capacity of 1350 metric tons per day (MTPD) based on the "state of the art" low energy process of Haldor Topsoe A/S and two lines of urea, each having a capacity of 1125 MTPD based on the Snamprogetti SpA technology incorporating several low energy features. The related facilities of off-site and utilities consist of a captive power and steam generation plant(CPSGP) with two gas turbines, two heat recovery units and one service boiler , cooling towers, ammonia storage, naphtha storage, inert gas plant, effluent treatment plant, etc. The overview and interconnections between the various sections are shown in **Figure: 3.**

The fertilizer complex at Babrala is one of the six inland located fertilizer complexes based on a cross country HBJ ( HAZIRA-BIJAIPUR-JAGDISHPUR) natural gas pipeline. The pipeline transports associated gas from Bombay High and natural gas from South Basin to the fertilizer and power plants located inland. Babrala happens to be located at the tail end of the pipeline and, experiences therefore frequent fluctuations in gas supply pressure and quantity. As a consequence, normally 70% of the total requirement of feedstock and fuel is being met with the natural gas and the balance is met with naphtha. Naphtha is drawn in rail tankers from a refinery in Mathura located at a distance of about 150 KM by rail.

The complex is based on the Haldor Topsoe ammonia process and the Snamprogetti ammonia stripping process for urea manufacture. The plant is based on the use of dual feedstock and fuel for manufacure of ammonia and urea capable of using natural gas or naphtha as feedstock or fuel in primary reformer as well as fuel.in the captive power and steam generation plant. Apart from the main reason for tiding over the crunch in prime feedstock (by supplementing natural gas with light naphtha as the next best choice as hydrocarbon feed), (a) imparts greater flexibility in operation and (b) allows full conversion of ammonia for a dedicated urea plant downstream. The process flow diagram of the ammonia and urea process adopted at Babrala is shown in **Figure:4**.

The plant was designed on the concept of using the state of the art technology to achieve the

- Irreducible minimum levels of energy consumption in the process and steam and power plant.
- Irreducible level of water consumption
- Irreducible levels of liquid and gaseous emissions and noise.
- Irreducible minimum manpower for improved productivity.
- Irreducible levels of risks.

## Salient features of the Complex

The fertilizer complex at Babrala has several unique features. One of them is the integrated energy network. For the design and synthesis of the utility system, a systematic, thermodynamically oriented method was adopted for achieving the maximum possible overall efficiency.

The various energy saving and improved configurations for the main process plant were evaluated and the most appropriate were selected.

The ammonia plant was based on following special considerations.

- Flexibility with respect to feedstock(natural gas/naphtha). Adiabatic prereformer to accept the low aromatic and high aromatic naphtha.
- Flexibility with respect to fuel (natural gas/ naphtha) both in reformer and also the captive power and steam generation plant.
- Demineralized water preheat for entire complex integrated in the ammonia plant.
- Steam generation in front end and loop boilers.

- Synthesis loop with two converters. The well known Topsoe S-200 ammonia synthesis converter, a two bed radial flow converter with indirect cooling between the catalyst beds followed by a Topsoe S-50 radial flow converter.
- Purge Gas Recovery unit is also installed.

Urea plant at Babrala is based on Snamprogetti ammonia stripping design having a high pressure stage operating at 145 kg/cm2g, medium pressure stage operating at 15.5 kg/cm2g, LP stage operating 3.0 kg/cm2g and two stage vacuum stages. Prilling tower and waste water treatment section are common to both the streams of Urea Plant. Waste water treatment section is provided with a deep hydrolyser operating at 35 kg/cm2g and 225 deg.c. generating treated process condensate having less than 5 ppm of ammonia and urea. Smanprogetti based on their experience and preference of TATACHEM for energy reduction concepts incorporated following new features:

a) Provision of Vacuum preheater
b) Provision of scrubbing separator
c) Tall Prilling Tower with conical bottom.

Advanced instrumentation and control system based on Tata-Honeywell TDC 3000 PM version have been provided for the complete complex in one common control room. Recentally mass spectrophotometer have been installed and is under trial run which shall make on like stream analysis data available for dynamic control. With this dynamic and multivarient conrol is feasible by incorporating:

1. Reformer fuel LHV
2. Reformer Feed potential Hydrogen
3. Reformer steam to carbon ratio
4. Reformer methane leakage
5. Loop H2 to N2 ratio
6. Loop inert purge
7. Comverter temperature
8. Refrigeration Purge

The plant has gone in commercial production and has achieved very high capacity utilisation of the order 135% and low energy and emissions levels surpassing the performance of similar plants in the country. The performance compares with many of the similar modern plants in other part of the world and is tabulated in **Annexure-VI**.

The overall design of the complex is based on the "true" low energy concept which not only assumes low fuel consumption, but is based on wider meaning, considering it equivalent to the low cost of the produced urea. The battery limit cost of urea as the sum of the variable plus the fixed costs is strongly influenced by stream factor, reliability, pollution, plant capacity, product quality. It is clear that it is useless to have an apparently efficient process if the plant based on it has low stream factor, is not reliable or is affected by high pollution and low product quality. Availability, Efficiency, Safety and product purity with minimum environmental impact are the basis on which the Tata Fertilizer Complex was developed.

For minimization of pollutant release the strategy followed is to

(i) stop the pollutant from being generated,
(ii) if generated, stop it from being emitted, and

(iii) if emitted, collect it and recycle, treat, concentrate or burn it. The basis is how the pollutant can be eliminated economically. The emissions from the complex are shown in **Figure:5**.

## AREAS FOR IMPROVEMENTS

The plant has achieved very low levels of energy consumption and environmental impact. To further improve the performance the following strategies are proposed.

- Energy analysis to identify areas for further reductions and optimization.
- Reducing use of chemicals such as acid and caustic in the operation of the water purification plants by adopting the multieffect distillation and electrodeionisation(EDI) techniques. There is potential to use the low level waste heat from the main process plant and use it for water purification by evaporation instead of chemical consuming ion exchange demineralization process being currently used.
- To eliminate the use of harmful chlorine and chemical microbiocide in cooling water for microbial control and replace them with environmentally more acceptable ones like chorine dioxide, ozone with bromine. This will reduce discharge of certain potentially harmful complex chemical biocides in the cooling tower blowdown effluent.

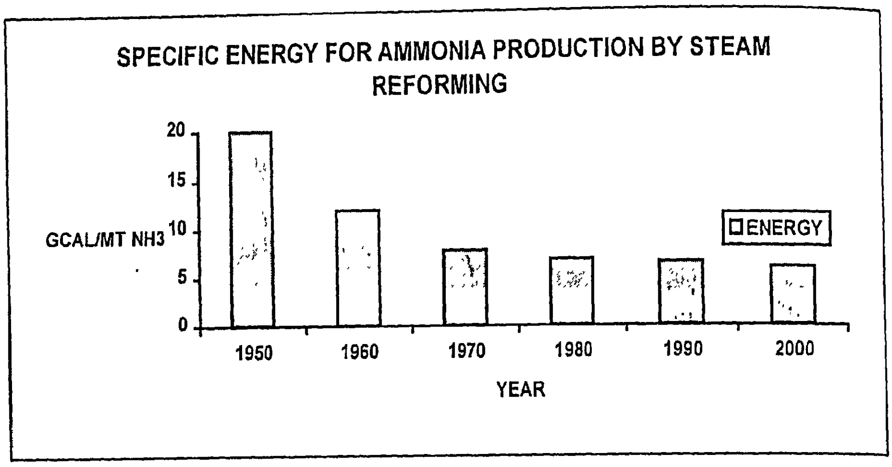
These concepts are the scope of this project report.

## PROPOSED STRATEGIES FOR IMPROVEMENTS IN ENERGY USE

### ENERGY ANALYSIS

Energy Requirements

Since the development of the Haber Bosch process for industrial ammonia synthesis the energy required to manufacture ammonia has been continuously reduced from approximately 20 Gcal/mt NH3 in the early 1950s to a current level of about 6.5 Gcal/mt NH3. During 1996-97 there was a production of 10.22 million tons of ammonia with capacity utilisation of 90%. The weighted average energy consumption of all the plants in the country was 10.88 Gcal/mt of NH3. There was 15.8 million mt of urea production showing a capacity utilization of 94.8% during 96-97. The weighted energy consumption for all the urea plants in the country was 7.78 Gcal/mt urea. The technically feasible levels is 6.0 Gcal/mt NH3.The reduction in energy demand of NH3 production over the last 50 years is depicted in the figure below. Despite this reduction , the energy demand is still about 33% above the theoretical minimum required for producing ammonia using the steam reforming route. The energy requirement for urea production is currently about about 0.5 Gcal/mt urea, not taking into account the energy needed to compress the carbon dioxide to synthesis pressure. Taking the energy for compressing the CO2 with steam turbines the energy requirement will be about 0.9 Gcal/mt urea. In a fertilizer complex where the ammonia produced is captively used for conversion to urea the technically possible minimum energy requirement of the complex including the utilities plants is about 4.8 - 5 Gcal/mt urea. The TATACHEM- Babrala complex has achieved an energy level of 5.3 - 5.4 Gal/mt which has potential for further reduction. The proposed pinch and exergy analysis will help identify the areas for improvements.



## Objectives of analysis

The long term planning of any process plant operations, specially that of the complex, energy intensive and high risk ammonia-urea plant, is generally performed according to following following set of criteria consisting of

- Cost
- Reliability
- Environmental impact
- Energy Efficiency

Energy conservation through energy efficiency

There is source of energy that produces no radioactive waste, nothing in the way of petrodollars, and very little pollution Moreover, the source can provide the energy that conventional sources may not be able to furnish. Unhappily, however it does not receive the emphasize and attention it deserves.

The source might be called energy efficiency, for most of the people of the people like to think of themselves as an efficient people. But the energy source is generally known by the more prosaic term conservation. To be semantically accurate, the source should called conservation energy, to remind us of the reality, that conservation is no less and energy alternative than oil, gas, coal or nuclear. Indeed, in the near term, conservation could do more than any of the conventional sources to help the world deal with the energy problem it has.

There is a great flexibility in how much energy is required and how much is actually used, for this or that purpose.

Three type are conservation techniques are curtailment, overhaul and adjustment. For economic reasons the curtailment or overhaul may not be feasible. The most productive conservation for an operating plant is adjustment. The pinch and exergy analysis techniques are the methods for carrying out adjustments for energy reduction based on the scientific principle of thermodynamics for optimization for the as operating or changed conditions of operations.

Of the four design criteria mentioned above (cost, reliability, environmental impact and efficiency), the last one should be expanded to include a broader definition of efficiency. Thus, efficiency should measure not only the input/output energy balance, but the '***quality***' of this energy transformation as assessed through ***exergetic*** analysis. The term *exergy* comes from the Greek and means ***available work***.

## Energy and Exergy Analysis

The First Principal of Thermodynamics (FPT) states that *energy can neither be created nor destroyed but can only be changed from one form to another.* Thus, for any energy conversion process,

*[INPUT ENERGY] = [USEFUL ENERGY] + [LOSSES]*

The energetic efficiency of a process based on the FPT is there

$\eta$=USEFUL ENERGY/INPUT ENERGY

The second Principal of Thermodynamics (STP) stated that during any energy transformation, the quality of the energy, as measured by its ability to perform work (exergy) degrades or at most keep it in its original state,

[Exergy(input energy)] $\geq$[ Exergy(useful energy)] + [exergy(losses)]

It is evident from the above inequality that, unlike energy, exergy is not conserved in a process. The destruction of exergy, create irreversibility, is something which planners must pay more attention to as it is closely linked to the rational use of energy resources.

The exergetic efficiency of a process based on the SPT is given

$\varepsilon$ =Exergy(useful energy)/Exergy (input energy)

The function Exergy can be related to energy by

Exergy = $\alpha$ Energy

Where $\alpha$ is a parameter dependent on other states such as temperature in the case of heat. In addition, a depends on the available technology for converting that particular form of energy into work. From above equations it can be shown that,

$\varepsilon/\eta = \alpha_{out} / \alpha_{in}$

where $\alpha_{in}$ and $\alpha_{out}$ are the $\alpha$'s corresponding to the input and output sources of energy respectively.

The objective of the proposed work will be to identify cost effective energy reduction projects by the application of Pinch and Exergy analysis techniques. This will be determined from a comparison of the Target utilities consumption obtained by Pinch analysis with the actual utilities consumption as taken from operating data.

The second law of thermodynamics teaches that the different forms of energy have different values. Thus, work has a higher value than heat, heat at a high temperature has a higher value than heat close to ambient temperature. While energy flows through a process and is transformed into a variety of form, its quantity remains unchanged while its quality is degraded. The minimization of this degradation is the goal of energy optimization of a process. Thermodynamics provides us with a quantity that measures energy degradation, and this quantity is the exergy loss. Minimization of all exergy losses necessarily leads to a minimum of energy consumption of a process. In theory exergy losses can be reduced to zero by intelligent technology. In practice this is not feasible because sufficiently intelligent technology may not be available or is too expensive. Thus, one has to compromise. In order to find the right compromise systematic methods for the process analysis and process optimization are required. Two such methods are pinch analysis and exergy analysis. Since both methods rely on the laws of thermodynamics, they lead to the same results when properly applied to the same problem. Since pinch analysis essentially is limited to exergy loss minimization by heat integration, the optimum design of heat exchanger networks is a problem where both methods can be shown to converge in principle. In practical applications, they are quite different. While pinch analysis has been worked out as a practical tool for finding the optimum heat integration under well-defined conditions, exergy analysis does not give clear insight about the route to a better process structure. It allows, however, a rational comparison of different energy forms and different process structure and thus, by trial and error, also leads to an optimum process.

## Pinch Design method for Heat Exchanger Network(HEN)

Heat exchanger network (HEN) design is a key aspect of chemical process design. Typically, 20 - 30% energy savings, coupled with capital savings, can be realized for a state of the art flowsheet by improved HEN design. The task involves the placement of process and utility heat exchangers to heat and cool process streams from specified supply to specified target temperature. The objective is to minimize total costs, i.e. capital and operating costs expressed as annual charges. Development of systematic procedures to meet this objective has been an active area of interest. The approach to the problem has been altered by two major discoveries : network performance target and the network temperature pinch.

The network temperature pinch represents a bottleneck to feasible heat recovery in HEN design. By fully exploiting the properties of the pinch the task of optimal HEN design is greatly simplified.

Network performance targets exists for the minimum utility usage, the minimum overall surface area, and the minimum number of "units" (i.e. process and utility exchangers). Calculations of these targets is simple and is possible independent of design. Thus, targets can be used, first to stimulate the designer towards better designs, and second to give the designer confidence that his solution is near optimal.

The scope of work suggested to meet the above objective shall be

## Phase I . Scoping Analysis

Phase I is intended to identify the scope for improvement in the existing process operations.

Breakdown of the activities in this phase are as follows:

- Obtain and reconcile heat and mass balance data for the plant and the utility system.
- Extract stream data for Pinch and Exergy Analysis.

- Select appropriate minimum approach temperature (DTmin). This is based on a number of factors, including approach temperature used in the existing plant, experience of similar applications, sensitivity of energy target to DTmin etc.
- Generate initial composite and grand composite curves.
- Identify significant opportunities for improvement through composite curve analysis.
- Review the cost data for utilities to be applied to incremental investment decisions.
- Prove match the process grand composite curve with ideal utility system envelope.
- Generate balanced composite curves to identify the key "Pinch" points.

While performing the above steps for each of the process units, the utility system shall also be studied to

- Construct a model of the steam/power system.
- Review the heat and power trade-offs for the utility system.
- Evaluate the trade-off between the number of steam mains and energy efficiency.

## Phase II - Conceptual Design

The objective for Phase II will be deliver the conceptual heat exchange network designs for each of the process units. This step would insure the designs are robust for the suggested operating cases.

The breakdown of the activities during Phase II shall be

- Incorporate comments from the Phase I review and revise the final targets as necessary.
- Design a heat exchanger network which satisfies, as far as reasonably practical, the phase I capital and energy targets.
- Review the network for safety and operability.
- Modify the design to account for comments accepted in the review meeting.
- Ensure operability over the cases required.
- Prepare final report.

## Anticipated Benefits

The benefits through the application of Unit Pinch Optimization, Exergy Analysis and steam/power system model could be either energy savings or increased capacity, or both.

The exact savings that would result from the above analysis can be established only after the review of the process operations and data analysis. The case studies of similar analysis carried out earlier in ammonia-urea plant indicated that savings in energy upto at least 8% of the total present consumption can be obtained with projects having an overall average payback of less than two years. These improvements would include both a reduction in overall energy demand and/or capacity increase.

For the size of the fertilizer complex the reduction by 8% in total energy demand means annual savings of Rs. 15 to 30 crores depending whether natural gas is the feed or fuel in the complex.

The simulation model is then available for all future retrofit or energy system studies or addition of new process and carrying out the most efficient integration. The model can also be used for energy and emissions audits.

The model can be run to evaluate the option of various new retrofit available in future which are likely to emerge feasible due to energy resource costs escalations.

Cost of the study and software model development

The development of the software model of the plant utility system and the ammonia and urea process will be about Rs. 15 to 20 lacs and the services are offered by Linnhoff March, UK and Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany. In India KTI Ltd also offer these services in association with Linnhoff March, U.K. Under the Program for Acceleration of Commercial Energy Research (PACER) funded by United States Agency for International Development(USAID), ICICI in India are working together with KTI, New Delhi and Linnhoff-March, USA for undertaking demonstrations projects in the area of Pinch Technology. The objective of such projects is to demonstrate the benefit of Pinch Technology to the industry. The demo projects are done under an agreement wherein the cost for the study is financed by ICICI with share in the benefits accrued on implementation of energy reduction schemes emerging out of the study.

## RESULTS OF PUBLISHED CASE STUDY OF ENERGY ANALYSIS IN SIMILAR PLANT IN CANADA

The pinch and exergy analysis was carried out in an extensive study conducted at the Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany to identify possibilities for further energy optimization of a modern fertilizer complex. The ammonia and urea complex was designed and built by Uhde of Dortmund, Germany and went into operation in 1992 in Belle Plaine, Cananda. The site consists of a single train ammonia plant with a capacity of 1,500 t/d ammonia and a single train urea plant with a capacity of 2,000 t/d urea. The major part of the ammonia produced (1160 t/d) as well as the most of the carbon dioxide are used as raw material for the production of urea.The results as published in the study report is summarised below to show the nature of the pinch and exergy analysis of a fertilizer complex. There is good deal of similarity between the TATACHEM-Babrala fertilizer complex and the fertilizer plant which was the subject of the published study. Interestingly the study reveals that even a modern energy efficient fertilizer plant when subjected to such analysis reveals that the energy reduction is possible in future. The efforts of carrying out such a study and development of computer model for the TATACHEM-Babrala plant will be worth as the energy reduction strategies emerging out of the study will improve the profitability in future as the energy costs are certainly going to go up all the time. In an energy intensive modern fertilizer plant the energy reduction and to an extent reduction in use of chemicals in utility operation constituents the prime area for environmentally sustainable operations. Interestingly these measures improve the economics of the plant operation also.

The highlights of the findings in the plant studied in Canada along with the methodology involved are summarised below.

Pinch Analysis

Pinch analysis requires certain data, i.e. the stream data. These are the initial and the final temperature of a stream and its heat capacity $mC_p$.
The first step is the identification of the streams data from a flow sheet. The streams are classified into cold streams, i.e.such streams that need to be heated, hot streams, i.e. those that need cooling, and utilities, like steam and cooling water. In flow sheets we

normally find the temperature of the streams and the heat flows Q that are transferred in the heat exchangers. From these informations the heat capacity $mC_p$ can be calculated by : $mC_p = Q/\Delta T$
Some care is required not to use a constant value of $mC_p$ in an inadequately large temperature range. A simulation of the temperature curves in the exchangers is recommendable and sufficient to exclude such errors, in particular when condensation and evaporation processes are involved.

The second step in pinch analysis is the construction of the composite curves and the grand composite curve. In the plant studies a pinch temperature of about 100 deg.c was found. The grand composite curve reveals that for a minimum temp difference of $\Delta T$ = 10 deg.c. and pinch temperature of 100 deg.c the minimum heat requirement of 136 MW over a large temperature range between about 800 deg.c. and 100 deg.c.and minimum cooling demand of 74 MW and the hot stream to be cooled has a temperature below 100 deg.c.

It was deducted that the heating demand in the primary reformer can be met by external utilities while, at the same time the, the heat released after the secondary reformer can be used for HP steam generation. This is possible because, away from the pinch , very large temperature differences are available which provides great flexibility in matching the hot and cold process streams. Therefore, even if a match between the primary and secondary reformers are not possible, this would not necessarily lead to an increase of the minimum heating demand.

If the theoretical minimum heating demand of the plant is compared with the actual heating demand of 147 MW then a saving potential of 11 MW can be seen, i.e. a possible energy demand reduction of 8% compared with the actual demand.

In principle, it is always possible to design a heat exchanger network so that the energy targets identified with the help of a pinch analysis are realized. However, it can be inferred from the composite curves that approximately 100 MW heat has to be transferred from hot to cold process streams in the temperature range between 50 and 150 deg.c., i.e. in the range around the pinch. This would require a completely new heat exchanger network involving considerable expense. Given the composite curves for the plant examined, which are very close together, it can be reckoned that a complicated network with a large number of heat exchangers would be required for a heat transfer in the range of the pinch.

For an existing plant, it is quicker and simpler to check the existing matches to see whether the heating demand can be reduced by simple measures. In order to do so, the existing heat exchanger network is checked for violations of the pinch rules. In the ammonia plant studied, there are several heat exchangers which break one of the three pinch rules and thus necessitate a heat supply which exceeds the minimum heating demand. The three pinch rules are:

- Do not use hot utilities below the pinch;
- Do not use cold utilities above the pinch;
- Do not transfer heat across the pinch.

The heat exchangers of the ammonia plant studied, which violates the pinch rules are

- Feed preheater synthesis loop

- Natural gas preheater
- Air preheater primary reformer
- Feed preheater primary reformer
- BFW preheater methanator
- Air preheater primary reformer
- BFW preheater CO2 separation
- Heat exchanger purge gas cleaning

The ways to avoid the pinch violations are described in the study. Since the changes in the heat exchange network especially in the primary reformer convection part have a high impact on investment and hence such measures are only economical if a new primary reformer is being constructed as part of expansion.

### Results for Urea Plant

The pinch analysis of urea plant carried out in the referred reveals that no pinch violations exists, i.e. that no further reduction of the required heat input can be achieved by a better heat exchanger network. While the considerable amount of heat to be rejected from the urea plant cannot be used as heat in the process a part of it is at high enough temperature to produce low pressure steam for power generation. Such low pressure steam production is realised in the actual process to some extent, but pinch analysis suggests that it could be increased. The technical measures that are required for such an increase can easily be identified by application of the pinch rules. The capital costs associated with these measures have to be balanced against the cost value of the additional steam.

Basically, it can be expected to reveal a further potential for energy saving from an integration of both plants of the fertilizer complex, i.e. the ammonia plant and the urea plant. Thus, we executed a pinch analysis of the whole complex by putting together all hot and cold streams. Some interesting conclusions could be drawn from such an analysis. Since the pinch temperature remains practically unchanged for the case under consideration, the results of the separate analysis of both plants remain relevant. Integration of both plants leads to an energy saving potential of about 19 MW with respect to the existing fertilizer complex. More than 50% of this i.e. 11 MW, can be realised by modification of the ammonia plant alone as discussed above. Further 4 MW can be got by increasing the low pressure steam production in the urea plant, for which there was no use in the urea plant alone, but which now can be used in the ammonia plant. The final rest of 4 MW requires a complicated heat integration of both plants, that would be probably be impractical.

In total, we can say that pinch analysis gives a lot of insight into the heat economy of a process, a plant or a whole complex of plants. It leads to clear benchmarks of possible energy savings and to practical hints about how such potentials may be realised. It can also be coupled to cost correlations for heat exchangers and thus permits the calculations of return of investment costs.

### Exergy Analysis

Exergy analysis requires much more effort than pinch analysis since it takes a much broader view. In pinch analysis explicit knowledge of the entropy function and the exergy loss is not required since it is eliminated in terms of temperature difference. This limits pinch analysis to problems of heat integration. General exergy analysis considers all forms of energy. It explicitly calculates energy losses and therefore explicitly needs knowledge of the entropy function. This means a considerable effort in establishing the necessary data of the various streams. In fact, for complicated fluid systems, e.g. electrolyte solutions, present knowledge frequently precludes any explicit calculations of entropy, even when modern fluid property simulators are available. Thus, part of the urea plant could not be subjected to an exergy analysis, due to the lack of an adequate electrolyte model. In order to execute an exergy analysis the whole process may be subdivided in partial processes which are subjected to detailed exergy balances. **Annexure-VII** shows the results of such an exergy analysis for the ammonia plant. We can classify the total exergy loss of about 185 MW into an internal loss of about 175 MW and an external loss of about 10 MW. External exergy losses are associated with streams that are transferred to the environment without making use of their exergy contents. Besides the typical flue gas losses, here we have losses of synthesis gas on compression and rejection of carbon dioxide. Since most of the carbon dioxide removes from the synthesis gas is used in the urea plant and only a minor part is transferred to the environment this exergy loss is relatively small. It can be seen that the largest part of the internal exergy losses is due to chemical reactions, such as the combustion reactions in the primary and secondary reformer an din the auxiliary boiler. Such exergy losses have to be considered as unavoidable, since no technology is available to eliminate them. It is, however, useful to know their magnitude. A large portion of the exergy loss is due to entropy production on compression of air and synthesis gas. More sophisticated technology can reduce these losses, although the associated cost may render such measures uneconomical. The exergy losses due to heat transfer accumulate to about one quarter of the exergy losses. Exergy analysis as such does not provide any insight as how to reduce this exergy loss by designing a better heat exchanger network. This, however, has been achieved by pinch analysis in the as described before, which is an instrumentalisation of exergy analysis for the special case of heat exchanger networks.

**Annexure-VII** also shows the results of exergy analysis for the urea plant. Again, chemical reactions in the synthesis contribute significantly to the overall exergy loss. These losses are unavoidable. Also, the carbon dioxide compression is responsible for a large portion of the total exergy loss. This loss could be reduced by better machinery and use of the heat in the interstage coolers. The overall contribution to the heat transfer network to the total exergy loss is about 15%. This contribution has been already addressed by pinch analysis . The evaporation of water in order to concentrate the urea solution is responsible for another portion of the total exergy loss of about 15%. It could be basically be reduced by vapor compression. Generally speaking, the ammonia plant is responsible for the largest exergy losses, since more than 80% of the total exergy loss are caused by processes there.

### Pinch Analysis vs Exergy Analysis

Pinch analysis can be used either to design an optimum heat exchanger prior to process realisation or to work out a retrofit of a process already in operation. It considers the process as a whole system, i.e. modifications in the heat integration of parts of the system can be analysed in terms of their backeffects on the whole system. Pinch analysis further leads to a deep insight about the significance of heat in terms of temperature for a particular process. By using the pinch rules reasonable designs of combined heat and power systems as well as heat pumps become evident. Hence, a vapor compression in urea solution concentration as suggested by exergy analysis would be rules out by pinch analysis, since it would violate a pinch rule. Also, the combination of processes can thoroughly be analyzed by the pinch method, in particular its relevance to the steam system of an industrial site.

Exergy analysis starts from the components of a given process structure. It does as such not consider the process as a whole system and is basically unable to predict the backeffect of a change in one part of the process to the total process. Therefore, using exergy analysis to improve process structures requires the exergy analysis of various different process alternatives. This can clearly be done only in combination with effective simulation routines. While such routines can easily be set up for relatively simple processes, such as a power generation plant, they are generally not yet available for complex thermochemical processes. This may explain why exergy analysis has not yet become an established tool to analyse and improve process structures like the complicated fertilizer complex considered in the study. A major advantage of exergy analysis over pinch analysis is its generality which respect to all forms of energy. Although this generality is dependent on a somewhat arbitrary definition of the environment, to which the values of different energy forms are referred, it permits a rational comparison of all energy flows through a process. Generally, it is found that exergy analysis in this respect may be the comparison of various synthesis alternatives including the total process structure. Similar conclusions are valid for the selection of appropriate pressure levels of a synthesis.

## Conclusions

From the experience with a combined application of pinch analysis and exergy analysis to an existing fertilizer complex it is concluded that pinch anlaysis can be used and and effective instrument of retrofit. The benefits of exergy analysis are essentially linked to the comparison of different process structures. The practical applications would require a simulation tool for the process under consideration. With such a tool at hand exergy analysis and pinch analysis do not represent alternatives but rather two methods of analysis with their individual merits which should be combined to a total analysis.

## Proposal for TATACHEM- Babrala

Study similar to the one done at the operating plant in Canada and described above if carried out at TATACHEM- Babrala fertilizer complex will reveal the areas of further improvements in energy recovery and optimization. The simulation of the process with ASPEN and further development of pinch and exergy analysis for the complete complex including the power and steam utility plant is likely to identify improvements leading to energy reduction from the current levels of 5.4 Gcal/mt urea to about 4.8 GCal/mt urea. Additionally the analysis may provide additional recovery potential of low level heat from the compressor intercoolers etc which can generate additional LS steam. This steam can be used in water demineralization using multieffect distillation and eliminate the makeup water treatment in the existing Ion Exchange demineralization plant and reduce the use of acid and alkali in the DM plant reducing operating cost and TDS load in the effluent. Such scheme is also described in later chapters of this project report.

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# WASTEWATER MINIMISATION IN WATER DEMINERALIZATION PLANT

In the fertilizer plant at Babrala about 450 M3/hr Polished water(PW) is required for feeding as boiler feed water in the Ammonia Plant Waste Heat Boilers and the steam generators of the Captive Power and steam generation plant. The steam generated at 110 bar and 515 deg.c. is used for driving the steam turbines for the process air compressor, ammonia refrigeration compressor, syn gas compressor, CO2 compressors and the boiler feed water pumps and the process steam is taken as extraction at the required pressure level. The turbine condensate is sent back to the DM water plant for polishing for recycle. The process condensate after treatment in the process condensate treatment units of the plant is also recycled to DM plant. Of the 450 M3/hr of PW water supplied almost about 380 M3/hr is recycled back to DM plant. The recycled condensate is substantially clean water and needs only polishing treatment to make it suitable for use as boiler feedwater. The balance requirement of 70 M3/hr is obtained by using makeup water after deionisation(DI) through ion exchange units. This water deionisation is mixed along with the recycled condensate and further purified in a conventional mixed bed deionisation (MBD) units. The DI units and the MBD units are regenerated perodically using hydrochloric acid(HCl) and caustic(NaOH), which are hazardous materials. The process also wastes some water which again has to be replenished from raw water make up. The overall requirement of the makeup increases to about 120 M3/hr.

It is possible to apply alternative technologies for water purification which are more cleaner and avoid the use of corrosive and hazardous chemicals like the acid and alkali. The option which is proven and feasible is the use of Multieffect Distillation unit for deionisation of the makeup water and final purification and polishing along with the recycle condensate using the electrodeionization (EDI) units.

Water used by boilers needs to be of high quality and extra precautions and treatments are necessary. Typical water for high pressure boilers is purified first by pretreatment involving filtration etc., followed by deionisation in ion exchange units which use cation and anion exchange resins in separate vessels. The deionised water along with the recycle and treated condensate is purified in an MBD, which uses cation and anion exchange resins in a common vessel. While the DI and MBD process generate very high quality water, i.e., water with low dissolved salts (TDS), it also has some significant drawbacks. A noteworthy liability is that DI and MBDs must be chemically regenerated, which mandates purchasing, storing and handling hazardous materials,i.e., acid and caustic. Another disadvantage is the significant quantities of high- TDS wastewaters from regenerations that require neutralisation before discharge.

The main characteristics of the low temperature distillation unit are as follows:

- Unit based on multieffect process, for a high thermal efficiency and thus a low energy consumption.
- Unit operating at low temperature (less than 70 deg.c.) and at low concentration rates to avoid corrosion and scaling problems.
- Process requiring no sophisticated filtration or pretreatment of raw water.
- Unit fully automatic : the unit may be left unattended during operation.
- Simplicity of supervision and maintenance : no continuous control; no rotating parts besides the pumps.
- output of high purity distilled water, 24 hours a day whatever the salinity of raw sea water.

Raw water, recycle condensate and Polished water quality.

| Constituents Specification | Raw Water ppm | Recycle mixed condensate ppm | BFW ppm |
|---|---|---|---|
| Calcium, as $CaCO_3$ | 80 | 1 | ND |
| Magnesium, as $CaCO_3$ | 80 | 1 | ND |
| Sodium, as Na | 120 | 1 | <0.05 |
| Potassium as K | 5 | 2 | (Na+K) |
| Iron as Fe | 0.3 | 1 | <0.01 |
| Copper as Cu | <0.01 | <0.01 | <0.01 |
| Zinc as Zn | traces | <0.01 | ND |
| Ammonia | ND | 10 | ND |
| M-alkalinity as $CaCO_3$ | 260 | 10 | - |
| Chlorides as Cl | 40 | 1 | <0.03 |
| Sulfate as $SO_4$ | 100 | 1 | <0.02 |
| Nitrate as $NO_3$ | 0.2 | ND | ND |
| Phosphate as $PO_4$ | 0.02 | <0.02 | ND |
| Silica as $SiO_2$ | 20 | 2 | <0.02 |
| pH | 7.6 | 8.5 - 9.5 | 7+/-0.2 |
| Conductivity, µmhos/cm | 700 | 50 | 0.2 |
| TDS, ppm | 520 | 5 | 0.1 |

In the existing plant the high purity water is being consistently produced in the ion exchange units of the DM water plant. About 3 mt/day 30% HCl and 1 mt/day 47% NaOH is being used for the regeneration of the resins and find its way in to the effluent as regeneration waste.

It is interesting that the existing facility can be supported by installation of a 100 m3/hr distillate plant using the Multi effect distillation(MED) unit and further polishing of the distillate along with the recycle condensate in the existing MBD units which shall be able to reduce the acid to 0.5 mt/day and caustic to 0.5 mt/day. In case the acid and caustic consumption is to be totally eliminated the electrodeionisation units can be installed and used for polishing instead of the existing MBD units.

The MED unit can be substituted by an Reverse Osmosis (RO) unit in case the economics permit. The economics of MED are favorable compared to RO only if the 10 tons per hour of low pressure steam at 3 bar g is available as waste heat from the process. As it appears the urea plant if running efficiently is able to export 10 to 15 mt/hr LS steam which is partly being used in the effluent ammonia stripper and will be excess in case the effluent ammonia stripper operation is stopped on improved control on fugitive liquid discharges from the plant.

The preliminary analysis of the energy recovery potential in the ammonia and urea and the Heat Recovery Boilers of GTG indicate that LS steam or hot water generation potential exists, which can be used for the MED operation. In case of any shortfall the existing demineralization plant can always be used to generate the balance quantity of water.

The various options of water demineralization to reduce wastewater and chemical use are depicted in **Figure: 7**.

## ENVIRONMENTAL ISSUES IN MICROBIAL CONTROL IN COOLING WATER STRATEGIES FOR IMPROVEMENTS

### Need of cooling water

Water can be called the workhorse of the industry. With minor exceptions, water is the preferred industrial medium for the removal of unwanted residual heat from process streams. Clean water, once in abundance is becoming increasingly difficult to locate. In some instances, one plant's effluent is, with its chemical pollutants, the influent for another downstream. Also natural pollution is also being noticed in some of the water supplies including ground water in the form of presence of certain contaminants like phosphate, nitrates, iron, manganese and sulfides and salinity. Advanced water treatment and conservation techniques are therefore required to cope up with the situation. This applies especially to water used for cooling.

Open evaporative cooling water(cw) systems provide economical heat sinks since they possess the ability to handle high heat loads with a minimum of water loss, mainly attributable to evaporation. Thus, open evaporative cooling water provide efficient reuse of water. However, simultaneously this capability is associated with a very important phenomenon- the concentration effect. Evaporation results in the increased concentration of dissolved and suspended impurities in the remaining cool water. This concentration of impurities, combined with the natural action of water on system metals and temperature variations within a system leads to mariad of water related problems. To offset this, a portion of the system water is "bled off" intentionally in an attempt to deconcentrate. Even though bleeding assist in reducing many potential problems, the application of various chemical treatment including those for microbial control is required to maintain efficient operation and protect the system from water related catastrophes. In view of the high cost of these speciality chemicals the bleed off constitutes the recurring revenue loss . The bleed off also leads to environmental problems due the presence of increased dissolved solids and chemicals. The nature of many chemical process plant is such that the shutdown is not permissible due to the cost associated with the down time. This imposes severe demand on the chemical treatment as corrosion of process heat exchangers can cause shutdown as well as pollution.

Attempts are being made to reduce the heat reject from the process to cooling water by improved heat recovery in the process by the application of the energy analysis techniques like Pinch Technology. The fresh water demand for cooling is being optimized by the use of air cooling and the wet and dry type of cooling system. Further attempts are being made to raise the cycles in cooling water and reduce the blowdown. Attempts are being made to treat the blowdown and recycle it. In water scarce areas even treated wastewater is being used for make up. Reduction in blowdown water is the major cost reduction potential in the system.

### Microbial Problems

In the last decade , the cooling water treatment programs have developed from the experiences in the process industry. In the fertilizer industry it has become a area of special attention. The new hydrocarbon processing plants, in view of their single stream process and high capacity utilisation potential, are imposing high performance demands on the CW treatment programs. The stringent environmental regulations are demanding increased compliance. The Chromate based chemicals, successfully used earlier, are being phased out due to environmental restrictions. A good deal of success have been achieved in application of non chromate based corrosion inhibitors coupled with deposit control polymers for the control of corrosion and deposit problems. However the Microbiologically Influenced (induced) Corrosion **(MIC)** continues to be area of concern. The restriction on use of specialty biocides and emerging restrictions on extensive use of chlorine, microbial control is posing new challenges for the treatment programs. In fertilizer plant the presence of ammonia, nitrates, urea and phosphorous which provides the food for the proliferation of the bacteria aggravates the situation further. Microbiological control is emerging as the prime issue of concern in cooling water treatment programs in fertilizer plants. To a great extent the problem also exists in cooling systems of other process and utility plants. In fertilizer plant the cooling water has to take care of system metallurgy of carbon steel and stainless steel and the high heat fluxes encountered in the process cooling, facing process temperatures right up to 150 deg.c. and heat exchanger up to the rating of 20-30 Gcal/hr. The large size of the cooling system with high hold up volumes and associated stagnant areas, and likely ingress of nutrients due to leakages in the system, lead to proliferation of bacteria especially the troublesome ones, which can cause corrosion of carbon steel, stainless steel and other alloys.

In the fertilizer plant commissioned in the recent past in India, very high level of on stream factors and production levels have been achieved. Several plants in the past experienced problems in cooling water which caused limitations in production and increased downtime. The present trend of planning the plant turnaround after a gap of two or three years, demands that the cooling water treatment program should give low corrosion rates ( 1MPY or less) and avoid fouling due to scale or biofilm. The forced outages due to CW problems can be enormously costly.

In the recent past, a cooling tower was considered to be in acceptable biological control with bacterial populations of under 100,000 colony-forming units per millimeter (cfu/ml).With planktonic bacterial populations this high, the drift of water droplets leaving a cooling tower could contain billions of potentially harmful bacteria. Often this was the best that could be done without using dangerous chemicals or inducing excessive corrosion. However the outbreak of *Legionnaire* disease due to drift from cooling towers brought into focus the harmful effects of some of the pathogenic bacteria in cooling water.

*Legionnaire* disease first came into prominence in 1976, the result of pneumonia like epidemic which occurred among American Legionnaires attending a convention held at the Bellevue Statford Hotel in Philadelphia. Additional cases were discovered among persons who had been near the hotel. All told, 221 persons became ill and 34 died. An investigation by the centre for disease control (CDC) determined the causative agent to be a bacterial organism disseminated by the hotel's air conditioning cooling system. Since that time , subsequent outbreaks and sporadic cases of *Legionellosis* have occurred all over the world and in a number of cases cooling water systems played a key role. *Legionnaire* disease is an uncommon form of pneumonia. For control the CDC and Cooling Tower Institute advise adherence to the policy of implementing an effective microbiological control programme to reduce the risk. Emphasis should be placed on selection of the correct microbiocide. Another suggestion is the minimisation of tower plume or drift into air intake to buildings or air conditioning systems wherever possible. In some weather conditions this is very difficult.

Another problem associated with microbial infestation is the deterioration of cooling tower lumber. This not only reduces efficiency of cooling tower operation, but adds, substantially to the operating cost of the plant. Microorganisms growths also cause other problems by their presence, among them odors and environmental pollution.

### MIC and metallurgy

MIC can affect all types of metals used in CW systems. MIC generally cause intense localized attack. Mechanisms for MIC are different for SS and CS. Because of this, attempts to upgrade CS systems with types 304 SS and 316 SS to alleviate MIC problems have often been ineffective and have resulted in more problems in some cases. Failures in CS are most often attributed to SRB and APB activity. Failures in SS are often due to the formation of differential aeration cells resulting from the activities of metal depositing bacteria. Manganese and Iron oxidizing bacteria (MFOB) have long been recognized for their ability to deposit iron hydroxide or manganese oxide in structures outside their cells. Metal depositing organisms create environments that are conducive to corrosion, especially on metals that are prone to crevice corrosion. Metal depositing organisms create environment that are conducive to corrosion, especially on metals that are prone to crevice corrosion. Dense deposits of cells and metal ions create oxygen concentration cells and initiate a series of events that are individually or collectively extremely corrosive.

### Microbiological Control

The most practical and efficient method of controlling microbiological activity in cooling water is through the use of microbiocide, also commonly called a biocide. Microbiocide kill microbiological responsible for microbiological problem or inhibit their growth and reproductive cycles. Biocide perform their function in various ways. Some biocide alter the permeability of the microbe cell wall, thus interfering with their vital life processes. Others damage the cell by interfering with the normal flow of nutrients and discharge of waste.

Biocides can be either oxidizing or nonoxidising toxicants. The commonly used biocides are listed below

| Oxidizing biocide | Non oxidising Biocides |
|---|---|
| Chlorine and chlorine donors | Amine and ammonium compounds |
| Bromine | Organo sulfur compounds |
| Chlorine Dioxide | Thiocyanates |
| Ozone | Isothiazolones |
| | Organo halogen compounds |
| | Glutaraldehyde |
| | Guanidine compunds |
| | Organic thiocyano-azole compounds |

### Oxidising Biocides

Chlorine is the most prevalent industrial oxidising biocide. However chlorine becomes less effective at higher pH in alkaline environments. Chlorine is both an excellent algicide and bactericide.In presence of ammonia as is found in fertilizer plants the chlorine effectiveness substantially reduces due to formation of chloramines. The most troublesome SRB bacteria, Desulfovibrio can develop a strong resistance, requiring increase in chlorine concentration or a change to an alternate biocide.In presence of bioslimes chlorine penetration is impaired. To improve the effectiveness of chlorine, bromine chemistry is being tried which gives wider pH range and is not affected by presence of ammonia. The bromine use requires chlorine for generation of bromine from bromine compounds.

Another oxiding biocide finding wider application is chlorine dioxide(ClO2).This gas does not form HClO in water but exists solely as ClO2 in solution. ClO2 can be very effectively used in cooling waters contaminated with ammonia or phenols due to low demand for reaction with these species. Chlorine dioxide do not produce chlorinated organics as is the case with chlorine donors.

Another oxidizing biocide which is receiving more attention is Ozone. It is environmentally the most freindly biocide and has very high efficacy especially for slime control and is a strong biocide and its use leaves no harmful residues..

Chlorine donors

Chlorine donors are chemicals that release active "chlorine" in water, whose action is then similar to chlorine. Two chemicals commonly used in cooling water systems are sodium dichloro-s-triazine trione, or sodium dichloroisocyanurate and 1,3-dichloro-5,5-dimethylhydantoin. Since these two chemicals do not release "chlorine" all at once, but make it slowly available, they may be considered controlled release forms of the oxidising agent. Their modes of action are considered to be similar to gaseous chlorine, but it is possible that they could penetrate cell membranes and carry out their oxidative reactions from within the cell.

**Nonoxidising Biocides**

As indicated above there are number of nonoxidizing biocides to choose from. Selection of the proper biocide depends on a number of factors. These are the primary considerations:

- Type of microorganism
- Prior operating history of the system
- Type of process cooling water system
- Chemicals used for scale or corrosion control
- Water characteristics
- Environmental limitations and restrictions

Non oxidising biocides can be more effective than oxidising biocides because of their overall control of algae, fungi, and bacteria. They also have greater persistence, and many of them are pH independent.

An organo bromine broad spectrum nonoxidising toxicant is 2,2-dibromo-3-nitrilopropionamide(DBNPA). This molecule is an extremely potent bactericide and is only slightly effective as an algicide. It has little fungicidal activity. The toxicity of DBNPA decreases with an increase in alkaline pH.

Organic sulfur compound include a wide variety of different biocides of which methylene bisthiocynate(MBT) is the most common. Their mode of activity is through the inhibition of cell growth by preventing the transfer of energy or life sustaining chemical reactions from occurring within the cell. MBT is effective in controlling algae, fungi, and bacteria, most notably desulfovibrio . A shortcoming of MBT is its pH sensitivity and rapid hydrolysis in the alkaline pH range.

Under broader alkaline conditions, sulfur base biocide, such as bis trichloromethylsulfone and tetrahydro-3,5-dimethyl-2H -1,3,5-thiadiazine-2-thione, are more appropriate. The former is active in the pH range of 6.5 to 8, and the latter in more alkaline cooling water systems.

Isothiazolinone is a relatively new sulfur containing biocide. It is very effective in controlling algae and bacteria. it can be used over a broad pH range with no decrease in activity.

Quaternary ammonium salts are generally most effective against algae and bacteria in alkaline pH range . These compounds cause cell death by reducing permeability of the cell wall, preventing the typical intake of nutrients necessary to sustain life. Because of their surface active nature, these compounds are easily rendered ineffective in systems heavily fouled with dirt, oil, and debris.

Organic tin compounds, such as bistributyl-tin oxide are very effective against algae and fungi. They function best in the alkaline pH range and provide synergistic biocidal activity when combined with quaternary ammonium salts.

Glutaraldehyde (1,5-pentanedial) is an effective broad spectrum biocide capable of controlling slime forming and sulfate reducing bacteria, fungi, and algae. It functions over broad pH and temperature ranges and is compatible with chlorine. Glutaraldehyde is deactivated in systems containing NH3 and other primary amines, that is -NH2 groups.

Copper Salts

It is a well established that less than 1.0 ppm of copper (as Cu) dissolved in water will kill most algae and prevent their future growth. The action of copper sulfate on algae appears to be one of blocking the transport of oxygen through the cell membranes, leading to death by asphyxiation. The inner cell protoplasm is released, giving of the characteristic odor. Copper Sulfate is not recommended for direct use in cooling water applications. Overfeed of product and plating out of copper on mild steel or other non-copper surfaces would lead to severe pitting corrosion due to galvanic cells. In systems contaminated with ammonia addition of copper salts is not advisable. Additionally, because of environmental concerns copper is not recommended.

**Environmental concerns**

Till now the industries most significant requirement for a biocide were that it is effective against a broad spectrum of microorganisms, is cost effective, and possessed compatibility with the product application environment (including no interference with the scale/corrosion inhibitors). However, with the current interest in environmental responsibility (i.e., "greener "chemicals ), microbiocides must meet new demands:

- Broad spectrum of activity consistent with the application
- Very low toxicity
- Environmental acceptability
- Safety and ease of use in handling and storage
- Cost effectiveness

Table below lists a number of microbiocides that have become restricted or regulated because of environmental or human concerns in several countries.

| **Biocide** | **Reasons** |
|---|---|
| Mercury containing compounds | Potential human health effects such as to nervous system, and acute poisoning; concern for potential bioaccumulation in |

| | |
|---|---|
| | aquatic species. |
| Pentachlorophenol | Potential human health effects such as cancer,effects on reproductive systems and liver ; concern for aquatic toxicity and bioaccumulation. |
| Organotin compounds | Potential human health effects to the liver and immune system. |
| Simazine | Cancellation from swimming pool use because of excessive cancer risk. |
| Formaldehyde | Potential inhalation cancer risk |
| Chlorine | Potential for formation of chlorinated organics that may be hazardous to the environment and humans. |
| Chromium | Potential human carcinogen |

The new environmental legislation initiative are forcing manufacturers and users of microbiocides to realise that efficacy of an active substance is only one aspect in the future assessment of acceptability of a microbiocide. Comparisons will be driven by risk assesment of the toxicology and ecotoxicology of each substance in question.

Because of the high costs and intense scrutiny associated with new biocides, a very active research area is looking at combining two or more existing biocides as a means of reducing the amount of biocide needed for a given application or developing a more effective product for a specific application, and thus reducing the potential environmental impact. Along these lines, the use of nonbiocidal chemicals(such as surfactants, chelants, and dispersants) to improve the performance of existing biocide is being actively pursued.

## New Strategies

The new approach in controlling biofouling and MIC are based on what is believed to be the mechanism for biofilm formation. These new approaches being investigated to control biofouling are focusing on chemical treatment programme that do not function by killing the microorganisms, but by keeping the microorganisms from attaching to surfaces or by dispersing them from surfaces if they do become attached. The dispersed microorganisms then can be contacted and killed with the oxidising biocide such as chlorine or the more environmentally acceptable bromine, chlorine dioxide or ozone. Such chemical treatment programs are commonly referred to as biodispersants. Considering the complexity of the problem, completely replacing traditional biocide is not a possibility in the foreseeable future, but today's thinking is changing on how a new biocide are developed.

### Biodispersants

Biodispersants are typically nonionic surfactants.Among the most effective nonionic surfactants are formulations consisting of ethylene and propylene copolymers.

Biodispersants have no biocidal characteristics of their own; they are usually used in conjunction with oxidising and non oxidising biocides to enhance their effectiveness. Biodispersants lower the surface tension of the water, allowing the slime mass to disperse into the bulk water. This action makes a larger area of the biomass available for reaction with oxidising or non oxidising agents. By removing more of the slime mass, the biodispersant also accomplishes the following:

- Improves the heat transfer of the metal surface by removing the biofilm
- Reduces the potential for scale or fouling because less of the matrix is available for buildup
- Reduces the possibility for the existence of anaerobic corrosive bacteria

While there are chemicals currently being sold as biodispersants, success to date has no been such that they pose a threat to eliminating the use of traditional biocides. However, this should change in the future as more research effort is put into understanding how bacterial attachment to a surface can be eliminated. Research into the use of chemicals to prevent bacterial adhesion has shown the critical nature of the substrate to which the bacteria attach. For example, the current theory is that bacteria tend to more readily attach to hydrophobic surfaces rather than to hydrophilic surfaces. While numerous nonionic surfactancts have been found effective in preventing bacterial adhesion to hydrophobic or hydrophilic substances such as glass, they have not been effective for hydrophobic surfaces. Whether a surface is hydrophobic or hydrophilic once submerged in water depends in part on water contaminants present.

Research in the laboratory indicates that it is feasible to have one chemical effective for the control of a variety of organisms and surfaces. However, performance is dependent on the surface and the microorganisms, and a blend of chemicals will usually be required to effectively prevent biofilm formation on surfaces.

### Enzymes

Another approach receiving considerable attention is the use of enzymes to control biofilms. An enzyme is a protein molecule having both catalytic activity and specificity for the substrate. There are three approaches being investigated relative to the use of enzymes:

- Enhance the removal of biofilm where it has formed
- Prevent the formation of biofilm
- Improve the efficacy of biocides

One approach to controlling microorganisms deposits is with enzymes, which can catalyse the hydrolysis reaction of the extracellular polysaccharide produce by the microorgnisms after they attach to surfaces. Another approach is the use of enzymes is to disrupt the microorganisms attachment to surfaces, thus preventing biofilm formation.

## FUTURE OPTIONS

### Ozone-The green biocide

For microbial control, there is considerable pressure on the industry to develop chemical treatment programs that are safer, more effective and have less environmental impact than currently used microbiocides. While there are approaches being pursued (e.g.enzymes and biodispersants ), that may possibly eliminate the need for the currently used biocides. These techniques may provide some immediate benefit, however, in that they will make currently used biocides more effective against biofims, thus abating the environmental impact by reduction of the amount of biocide needed. Interestingly tests with use of ozone along with bromine and chlorine dioxide is showing encouraging results and may emerge as an greener alternative to specialty microbiocides. From previous uses of ozone in drinking water and wastewater treatment , it is known that ozone acts as a powerful oxidiser and a strong disinfectant. In addition, the short half life of ozone in aqueous solution results in minimal discharge of toxic biocide to the environment. Thus, the advantage of ozone with respect to other biocides are: minimal on site chemical inventory; nontoxic discharge; and potential for water conservation. As a cooling tower treatment, ozone has only recently become a viable option. Well controlled ozone systems have bacteria populations, well under 1,000 cfu/ml, often less than in the makeup water to the cooling tower. The unique combination of high toxicity during treatment with nontoxic discharge could make ozone the biocide of choice in future. Furthermore during the past decade, the successful control of corrosion in ozonated cooling tower water has been demonstrated in numerous field applications. It is established that corrosion rates in properly designed and maintained ozonated cooling systems typically range from 0.5 - 4 mils per year(MPY) for mild steel. According to industry standards these rates are good to excellent. Possible mechanisms considered for corrosion control provided by ozonation in cooling water systems are:

- The destruction and prevention of the growth of microorganisms that cause undersurface corrosion;
- The operation of ozonated systems under alkaline pH conditions which has long been known to reduce corrosion;
- The passivation of anodic metal surfaces which reduces corrosion in a manner similar to chromates or molybdates, etc.;
- The provision of anodic and/or cathodic protection through the adsorption of a passivating silicate layer on the metal surface.

## Conclusions

The microbial problems in cooling water systems are well understood and their damage is known and experienced. The most effective control method is being investigated taking into consideration the different conditions in various applications and also the environmental restrictions. It is imminent that these issues will be the focus of future for process industry in view of increasing gaps between turn-arounds and cost of shutdowns on account of corrosion and fouling of heat exchangers. Ozone is likely to emerge as the oxidizing biocide of future along with dispersants and eco friendly non oxidizing biocides. The additional ability of ozone as corrosion inhibitor will reduce eliminate the application heavy metal based(viz. chromate, molybdate, tungstate, zinc etc ) and phosphate and organic based corrosion inhibitors which creates stress on the receiving water bodies due to the continuous blowdown.

Cooling tower ozonation eliminated or greatly reduces blowdown, thus reducing the overall water consumption and decreasing operating costs. In addition, ozonation is functionally superior to multichemical programs with respect to scale control, corrosion control, and microbiological control. These observations are well documented in the literature by institutions and consultants and user companies.

The schematic drawing of ozone application in cooling tower is shown in **Figure:8.**

**Prospects at TATACHEM- Babrala**

At TATACHEM- Babrala two large open circulating cooling towers are in operation. The corrosion inhibitors are phosphate-zinc- polymer based and the microbial control is by continuous chlorination and periodical slug doses of microbiocides. Recently the chlorine dioxide is put on trial, which is the first application in India and the results are encouraging. The proposals are being sought for application of ozone and shall be evaluated for possible application in future.

The Project Report is prepared as part of participation in the Programme on Energy, Environment, Resources and Sustainability (PEERS) organised by Tata Energy Research Institute, New Delhi. The opinions and proposals in the report are of the author. The project report shall be presented to the organisation (Tata Chemicals Ltd) for feasibility studies, and/or implementation.

(S.G.CHOUDHARY)

Manager (O&U)

TATA CHEMICALS LIMITED,

FERTILIZER DIVISION, BABRALA

ANNEXURE-I

- Source IFA, World fertilizer production by region and major nutrient, 1994/95 (million mt)

| Region | N | P2O5 | K2O | Total |
|---|---|---|---|---|
| Africa | 1.2 | 2.2 | - | 3.4 |
| Asia | 37.9 | 11.0 | 2.3 | 51.2 |
| Latin America | 3.0 | 1.9 | 0.3 | 5.2 |
| Canada + USA | 14.9 | 9.8 | 9.8 | 34.5 |
| Europe + FSU | 20.6 | 5.6 | 10.5 | 36.7 |
| Oceania | 0.3 | 0.6 | - | 0.9 |
| Total | 77.9 | 31.1 | 22.9 | 131.9 |

| | | | | |
|---|---|---|---|---|
| DESIRED RATIO | 1 | 0.4 | 0.2- 0.3 | N:P2O5:K20 |
| ACTUAL RATIO | 1 | 0.26 | 0.3 | N:P2O5:K20 |

- WORLD POPULATION PROJECTIONS

| **REGION** | **1990** | **2000** | **2025** |
|---|---|---|---|
| LOW AND MIDDLE INCOME ECONOMIES | | | |
| • SUB-SAHARAN AFRICA | 495 | 668 | 1,229 |
| • EAST ASIA & PACIFIC | 1,577 | 1,818 | 2,276 |
| • SOUTH ASIA | 1,148 | 1,377 | 1,896 |
| • EUROPE | 200 | 217 | 252 |
| • MIDDLE EAST & N. AFRICA | 256 | 341 | 615 |
| • LATIN AMERICA & CARIBBEAN | 433 | 515 | 699 |
| **SUB-TOTAL** | 4,146 | 4,981 | 7,032 |
| OTHER (CIS, CUBA KOREA) | 321 | 345 | 355 |
| HIGH INCOME ECONOMIES | 816 | 859 | 915 |
| **WORLD** | 5,284 | 6,185 | 8,303 |

- DIFFERENCE IN CROP YIELD(1994)

| CROP | AVERAGE YIELD, KG/HA | | | BEST AVERAGE YIELDS | |
|---|---|---|---|---|---|
| | WORLD | INDIA | CHINA | | |
| WHEAT | 2,445 | 2,420 | 3,318 | 8,067 | NETHERLANDS |
| PADDY RICE | 3,651 | 2,817 | 5,869 | 8,336 | AUSTRALIA |
| MAIZE | 4,330 | 1,750 | 5,033 | 9,719 | NEW ZEALAND |
| CEREALS(TOTAL) | 2,830 | 2,107 | 4,500 | 7,146 | NETHERLANDS |
| PULSES | 847 | 607 | 1,338 | 5,011 | FRANCE |

ANNEXURE-II

## Typical inputs, outputs and atmospheric emission levels in modern ammonia plants

| | Conventional reforming | Excess Air reforming | Autothermal reforming | Partial oxidation |
|---|---|---|---|---|
| **Inputs** | | | | |
| Total energy (Kcal/t NH3) [a] | 7.65-8.37 | 7.65- 8.37 | 7.65-8.37 | 9.33-10.76 |
| of which | | | | |
| feedstock | 5.86 | 6.22 | 6.58 | 7.65 |
| fuel | 1.91-2.4 | 1.43-1.91 | 0.95-1.92 | 1.43-2.4 |
| water(t/t NH3) [b] | 0.7-1.5 | 0.7-1.5 | 0.7-1.5 | 1.2 |
| Air(t/t NH3) [c] | 1.1 | 1.6 | 2.2 | 4.0 |
| **Outputs** | | | | |
| Ammonia(NH3) t/d [d] | 1000-1500 | 1000-1500 | 1000-1500 | 1000-1500 |
| Carbon dioxide(CO2) (t/t NH3)[e] | 1.15-1.3 | 1.15-1.3 | 1.15-1.3 | 2.0-2.6 |
| **Atmospheric Emissions** [f] | | | | |
| CO2 (t/t NH3) in flue gas [g] | 0.5 | 0.4-0.5 | 0.2-0.3 | n.a. |
| NOx(kg NO2/t NH3) | 0.6-1.3 | 0.6-1.3 | 0.45-0.7 | 1.5-2.0 |
| SO2(kg/t NH3) | <0.01 | <0.01 | <0.015 | 1-3 |
| CO (kg/t NH3) | <0.03 | <0.03 | <0.015 | <0.13 |

a : High heat value (HHV). For steam reforming, values are for a stand alone plant with no energy export and no energy import except for feedstock and fuel. Where auto production of steam is insufficient and power is imported, total energy consumption may be less. For partial oxidation, values include imported power and/or auxiliary steam.

b : Values in steam reforming, depending on operation of process condensate recycle. Cooling water not included, variable from site to site.

c .Cooling air not included, variable from site to site.

d .Typical modern BAT plant, but can be up to 1800 t/d. Two commercial grades: technical grade-99 5% and refrigeration grade- 99.8%.

e .Not including CO2 in flue gases- see emissions. Depends on extent of air reforming and feedstock C/H ratio.

f :This table is not exhaustive. For example, partial oxidation plants may also emit H2S, methanol and dust traces, depending on the nature of the fuel and feedstock, and recovery procedures.

g :Figures assume by-product CO2 is recovered for subsequent use and not vented. However, this depends on the CO2 requirements of other plants on the site. Partial oxidation CO2 depends on fuel.

ANNEXURE-III

Typical inputs in modern urea plants(per ton urea)

| | CO2 Stripping | NH3 stripping | ACES process | IDR process |
|---|---|---|---|---|
| NH3(t) | 0.57 | 0.567 | 0.57 | 0.57 |
| CO2(t) | 0.75 | 0.735 | 0.74 | 0.74 |
| Steam(t) * | 0.77(ST)<br>0.8(E) | 0.76(ST) | 0.7(ST)<br>0.57(E) | 0.76(ST)<br>0.6(E) |
| Cooling water(m3)* | 60-70 | 80 | 51-60 | 60-75 |
| Electricity(KW)* | 54-396 | 76 | 108-436 | 72-432 |

* depending on whether the CO2 compressor is driven by electric motor(E) or steam turbine(ST).

ANNEXURE-IV

- Demand and supply of Naphtha and fuel oil in India in million metric tons

| Year | Overall (Power and Industry) | | | | Demand for fertilizer plants | | Overall gap | |
|---|---|---|---|---|---|---|---|---|
| | Demand | | Supply | | | | | |
| | Naphtha | FO/LSHS | Naphtha | FO/ LSHS | Naphtha | FO/ LSHS | Naphtha | FO/ LSHS |
| 98-99 | 6.3 | 13.2 | 7.2 | 10.2 | 5.5 | 2.9 | 0.6 | (-)3.0 |
| 99-00 | 6.9 | 13.6 | 7.8 | 9.8 | 6.8 | 3.0 | 0.9 | (-)3 8 |
| 00-01 | 7.2 | 13.9 | 10.1 | 12.1 | 8.4 | 3.0 | 2.9 | (-)1.8 |
| 01-02 | 7.2 | 14.2 | 12.2 | 13.0 | 11.0 | 3.0 | 5.0 | (-)1.2 |
| 02-03 | 11.7 | 17.5 | 15.5 | 15.5 | 11.0 | 3.0 | 3.8 | (-)2.0 |

- STATUS OF NATURAL GAS IN INDIA ( GAIL REPORT)

| | | |
|---|---|---|
| PROVEN GAS RESERVES | | 690 BCM |
| PRODUCTION | 1997 | 20.4 BCM |
| | 2003 | 30 BCM |
| DEMAND-SUPPLY GAP | 1998 | 26 BCM |
| | 2000 | 78 BCM |
| | 2005 | 120 BCM |

ANNEXURE-V

- Energy consumption of different feedstocks

| Feedstock and fuel | Requirement per metric ton of NH3 Energy (Gcal/MT) |
|---|---|
| Natural Gas | 8.6 |
| Naphtha | 9.4 |
| Fuel Oil | 9.7 |
| Coal | 12.5 |

- Capital investment according to different feedstocks

| Feedstock | Comparative capital investment |
|---|---|
| Natural gas | 100% |
| Naphtha | 114% |
| Fuel Oil | 147% |
| Coal | 187% |
| Electrolytic Hydrogen | 190% |

- Capacity of 'N' in India feedstock wise

| Feedstock | Capacity of 'N' in India % age |
|---|---|
| Natural Gas | 49 |
| Naphtha | 29 |
| Fuel Oil | 13 |
| Coal | 4 |
| Others | 5 |

ANNEXURE-VI

***__Ecoefficiency__*** targets and performance values achieved at TATACHEM Babrala

| Issue | Measure | Norm | Achieved |
|---|---|---|---|
| Water | M3/Mt of urea | 8-12 | 5 - 6 |
| % Recycle/Reuse of water in process | % | 50-70 | 80-90 |
| Energy | Gcal/mt of Ammonia | 7.6 - 8 | 7.3 - 7.4 |
| | Gcal/mt Urea | 5.7 - 6 | 5.3 - 5.4 |
| CO2(flue gases) | mt/mt of urea | 1 - 2 | 0.5 - 0.6 |
| NOx (flue gases) | kg/mt of urea | 0.5 - 1 | 0.3 - 0.4 |
| SOx (flue, desulfurisation) | kg/mt urea | 0.1 - 0.5 | 0.01-0.02 |
| Effluent | M3/mt urea | 3- 5 | 0 8 - 1.5 |
| NH3 in effluent | kg/mt urea | 0.05 - 0.15 | 0.05 |
| Urea in effluent | kg/mt urea | 0.05 - 0.1 | 0.02- 0.04 |
| Ammonia in air | kg/mt urea | 0.3 -1.0 | 0.4 -0.6 |
| Urea dust in air | kg/mt urea | 0.2 - 0.8 | <0.5 |
| Oil in effluent | kg/mt urea | 0.02-0.05 | < 0.005 |
| Sound level | dB | <90 dB | mostly <75 dB |
| Ambient Air Quality | | | |
| SOx | µg/m3 | 60-120 | BDL |
| NOx | µg/m3 | 60-120 | 20 - 40 |
| SPM>10µm | µg/m3 | 140-360 | 70 - 120 |
| RPM<10µm | µg/m3 | 60-150 | 20-90 |
| CO | µg/m3 | 2-10 | <2 |
| NH3 | µg/m3 | -- | 40 - 60 |

ANNEXURE-VII

- Exergy losses in the ammonia plant

| | Ev [%] |
|---|---|
| primary reformer | 35.08 |
| secondary reformer | 17.45 |
| auxiliary boiler+feed water pumps | 11.95 |
| synthesis gas compression | 6.44 |
| process air compression | 4.77 |
| carbon dioxide removal | 4.64 |
| synthesis loop (steam) | 4.53 |
| synthesis loop (reactors) | 2.83 |
| carbon monoxide conversion | 2.55 |
| ammonia removal | 1.34 |
| methanation | 1.20 |
| refrigeration | 1.01 |
| purge gas purifying | 0.54 |
| condensate stripping | 0.48 |
| SUM | 94.83 |
| losses by streams | 5.17 |
| TOTAL | 100 |

- Exergy losses in the urea plant

| | Ev [%] |
|---|---|
| Urea synthesis | 37.63 |
| CO2 compression | 21.85 |
| evaporator | 15.51 |
| granulator | 8.26 |
| steam system | 5.09 |
| deduster | 4.57 |
| process condensate | 2.74 |
| removal of inerts | 2.13 |
| fluidised bed cooler | 0.81 |
| fluidised bed cooler | 0.62 |
| SUM | 99.21 |
| losses by streams | 0.79 |
| TOTAL | 100 |

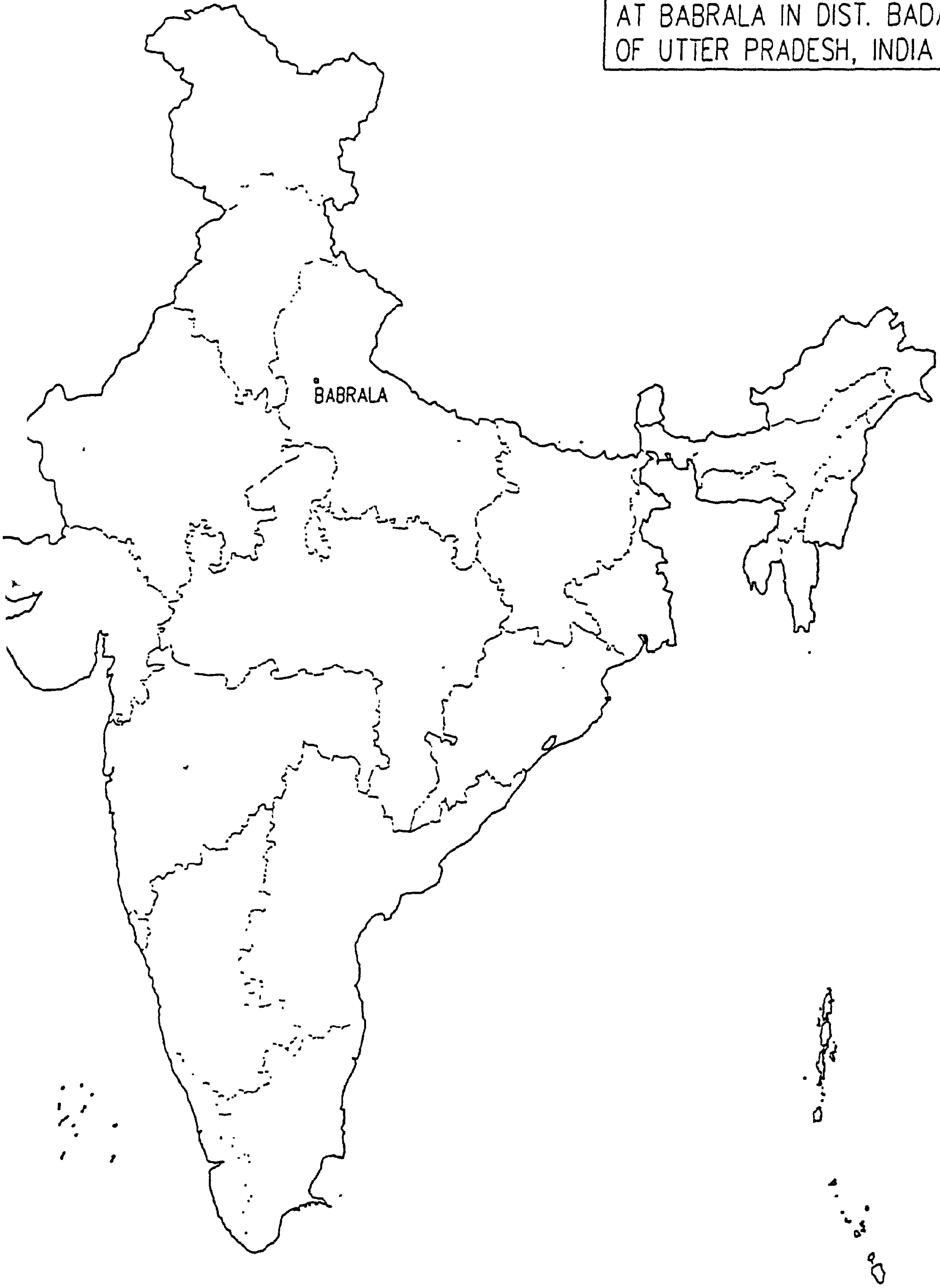


FIG:-1
MAP SHOWING LOCATION OF
TATA FERTILISERS COMPLEX
AT BABRALA IN DIST. BADAU
OF UTTER PRADESH, INDIA

FIGURE- 2: FERTILISER PRODUCTION ROUTES

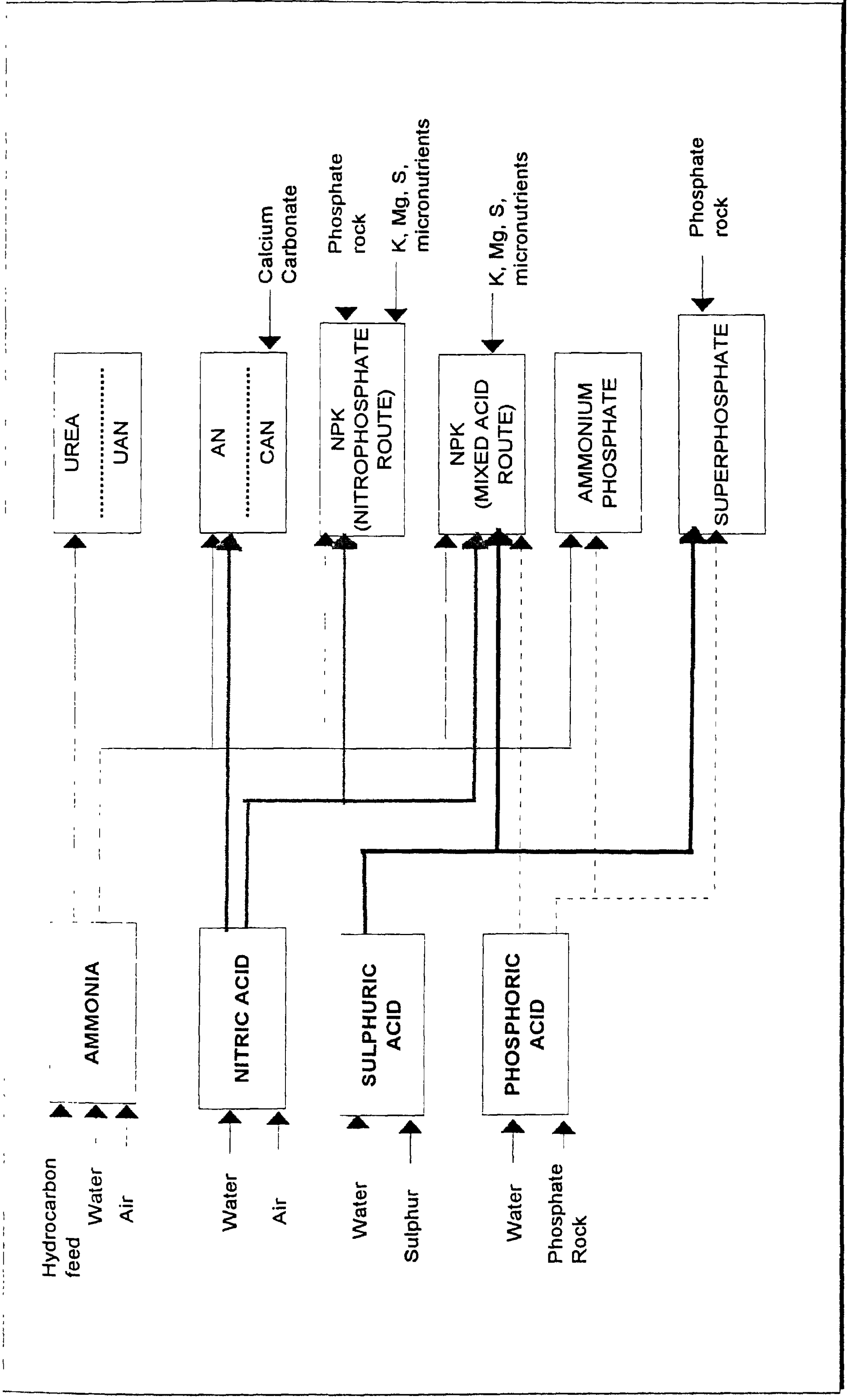


FIGURE-3: TATA FERTILISER COMPLEX- BABRALA - PLANT OVERVIEW

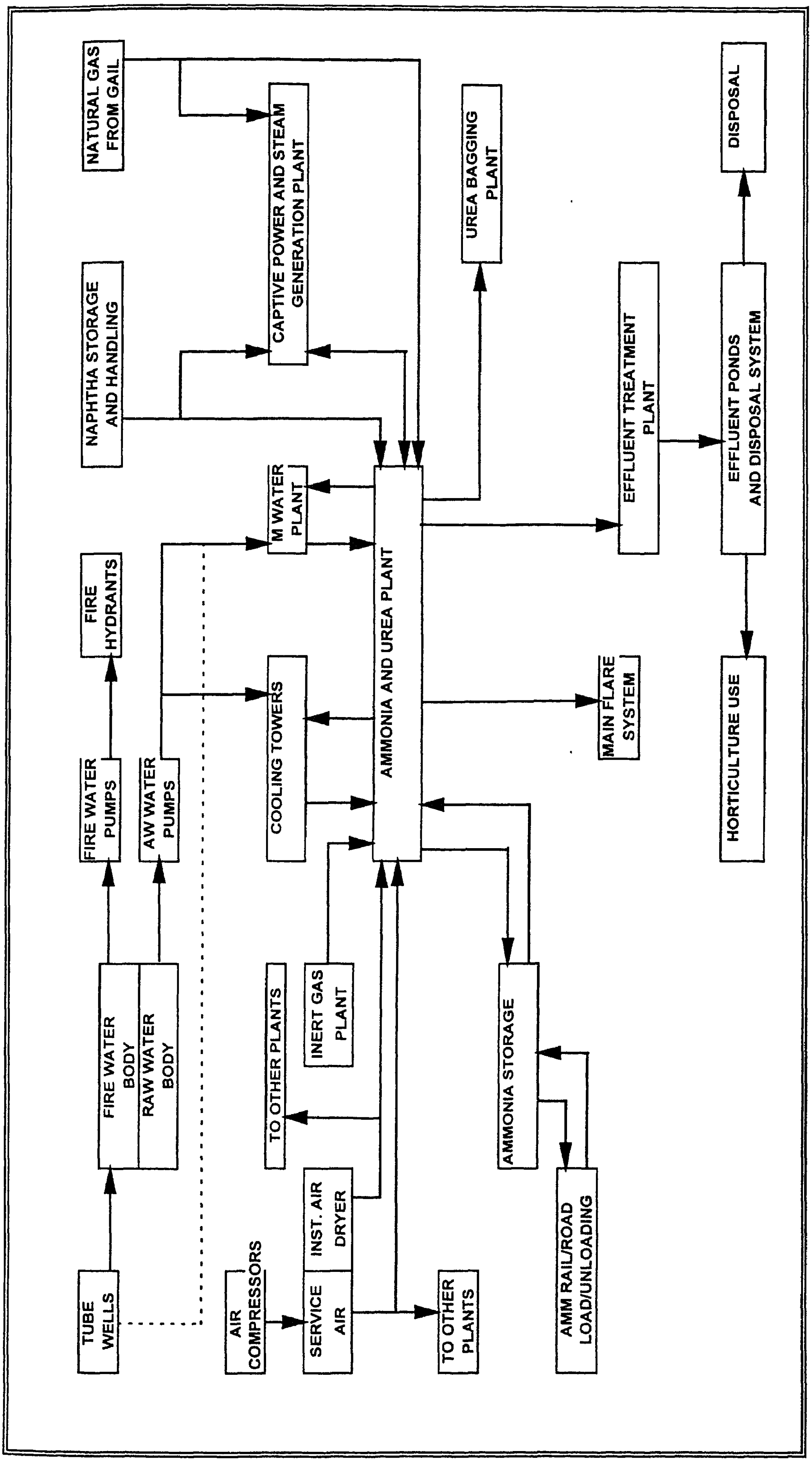
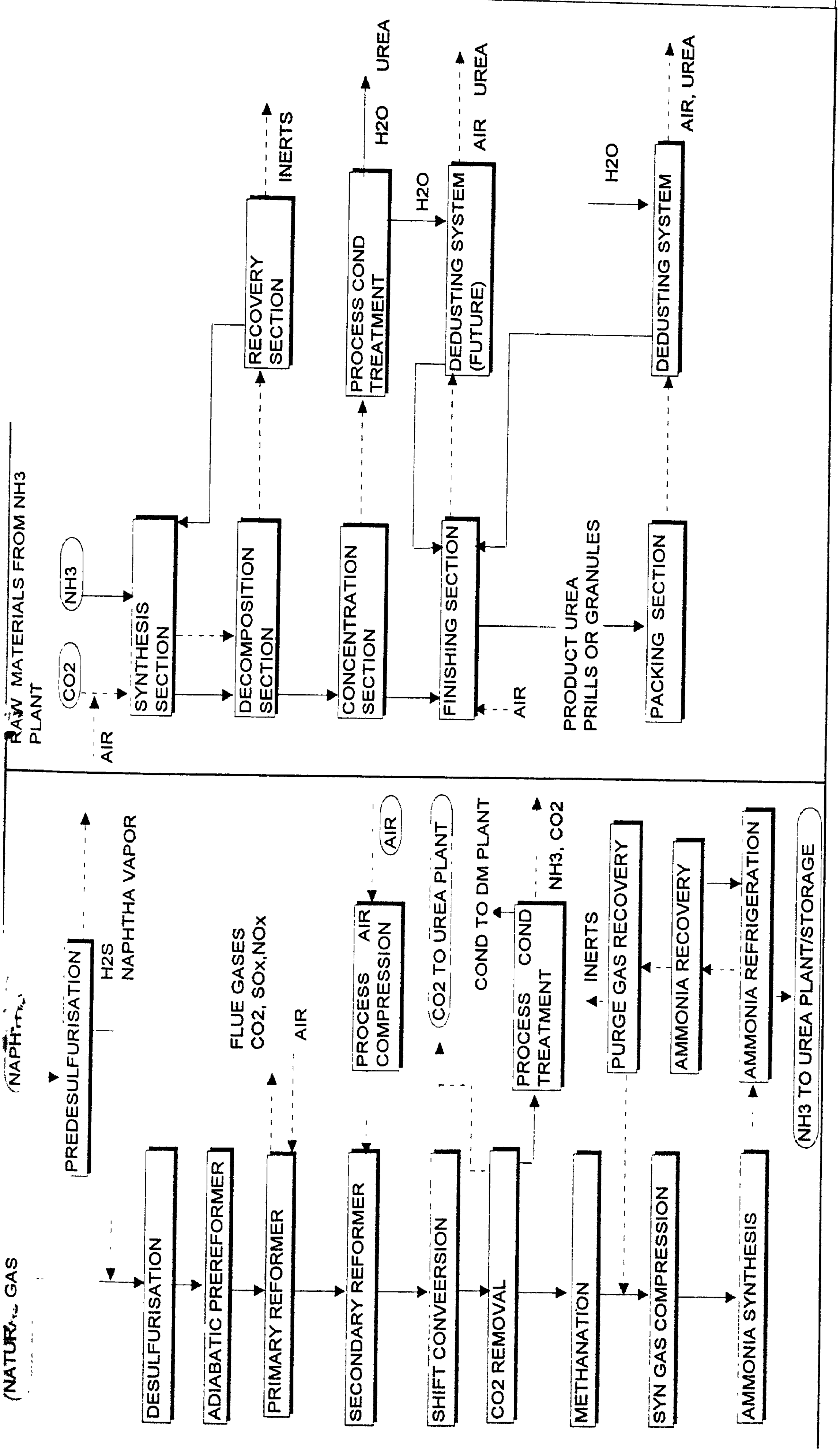


**FIGURE - 4: SCHEMATIC PROCESS FLOW DIAGRAM OF AMMONIA AND UREA PLANT AT TATACHEM BABRALA**



## FIGURE - 5: FLOW DIAGRAM OF THE PROCESS ALONGWITH EMISSIONS AND DISCHARGES

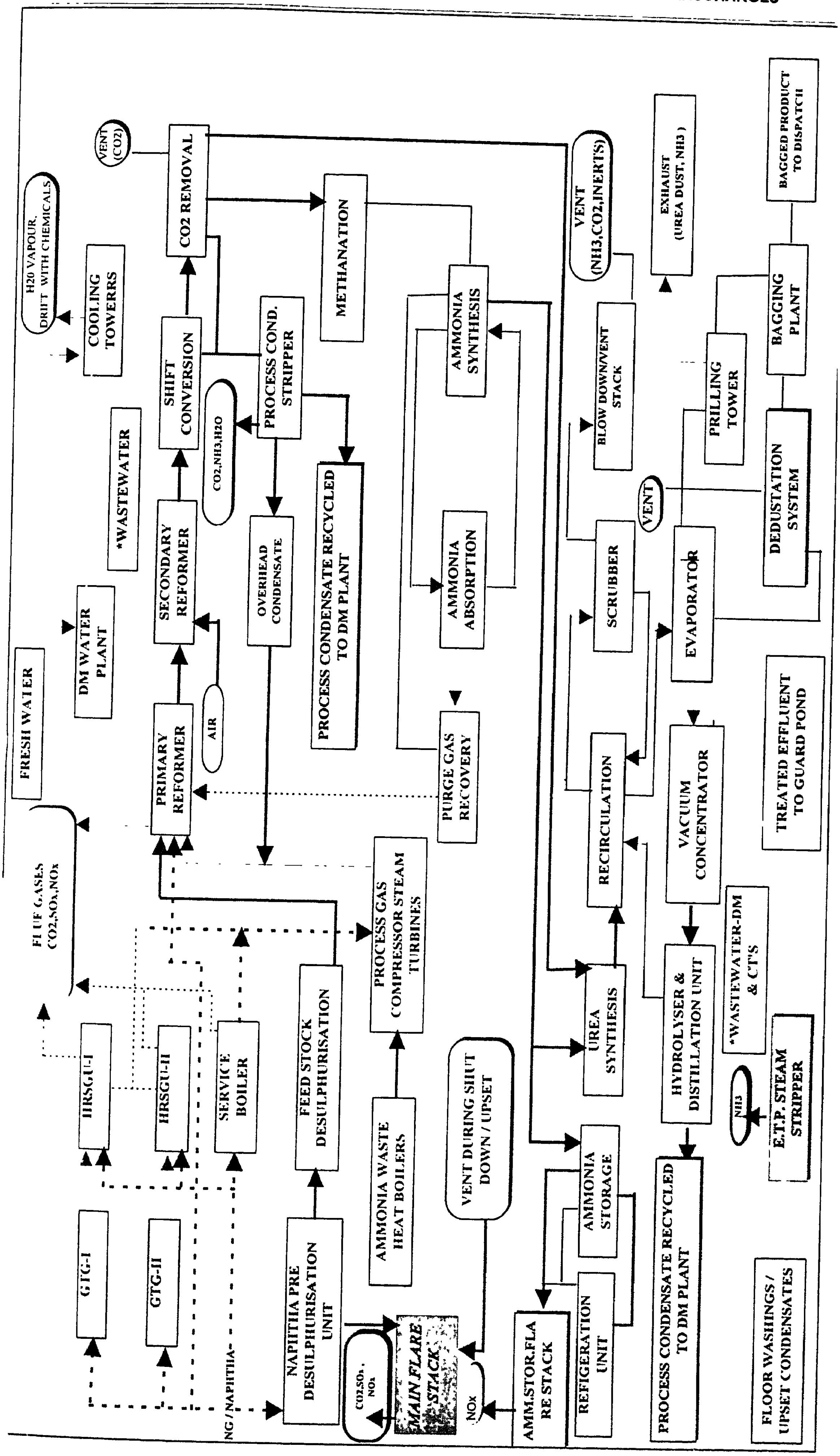


FIGURE- 6: CONSEQUENCE OF PRODUCTION AND USE OF UREA FERTILISER. RESOURCE REQUIREMENTS, EMISSIONS AND ENVIRONMENTAL IMPACT

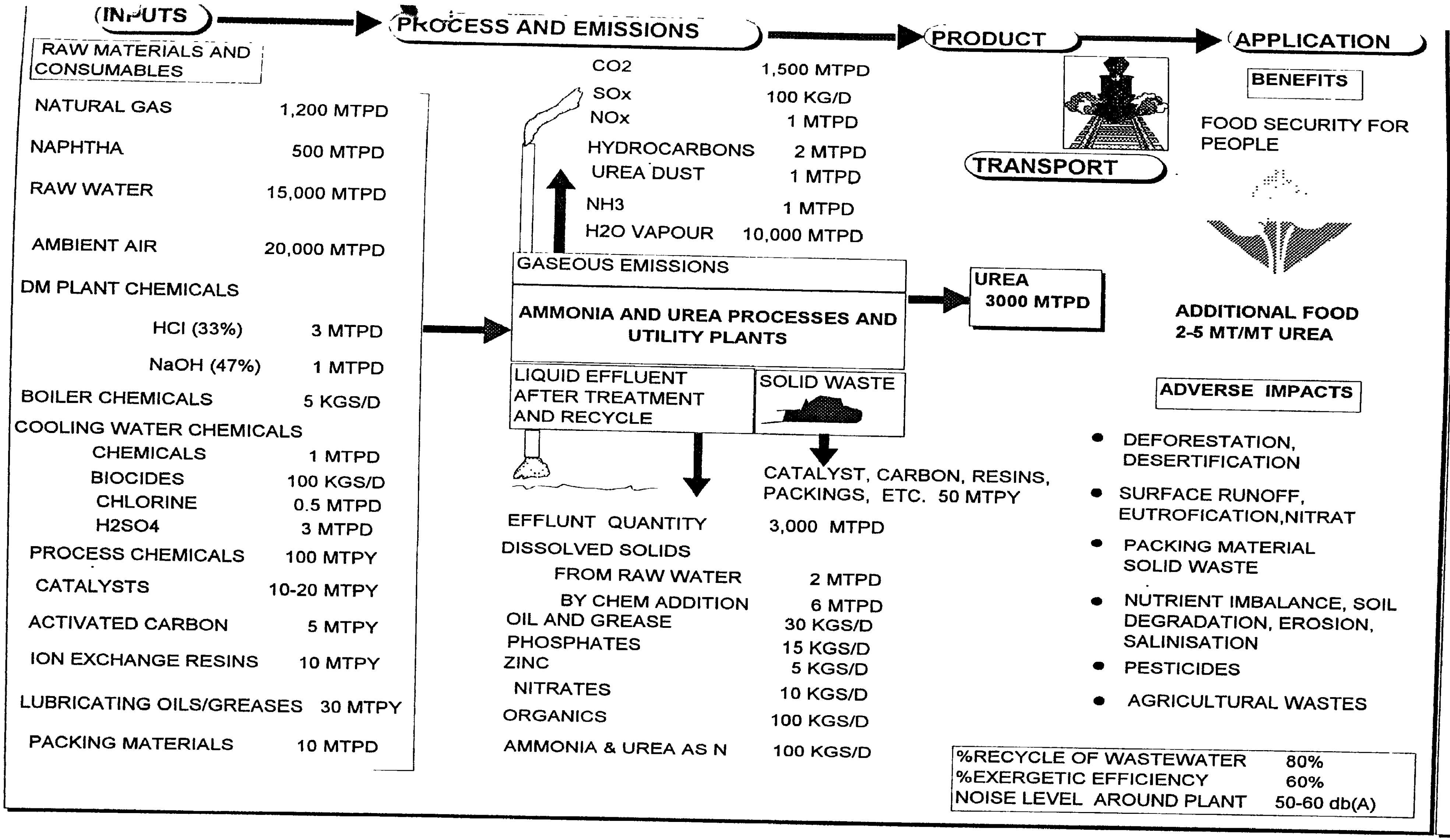


FIGURE-7: VARIOUS OPTIONS OF WATER DEMINERALISATION TO REDUCE WASTEWATER AND CHEMICAL USE

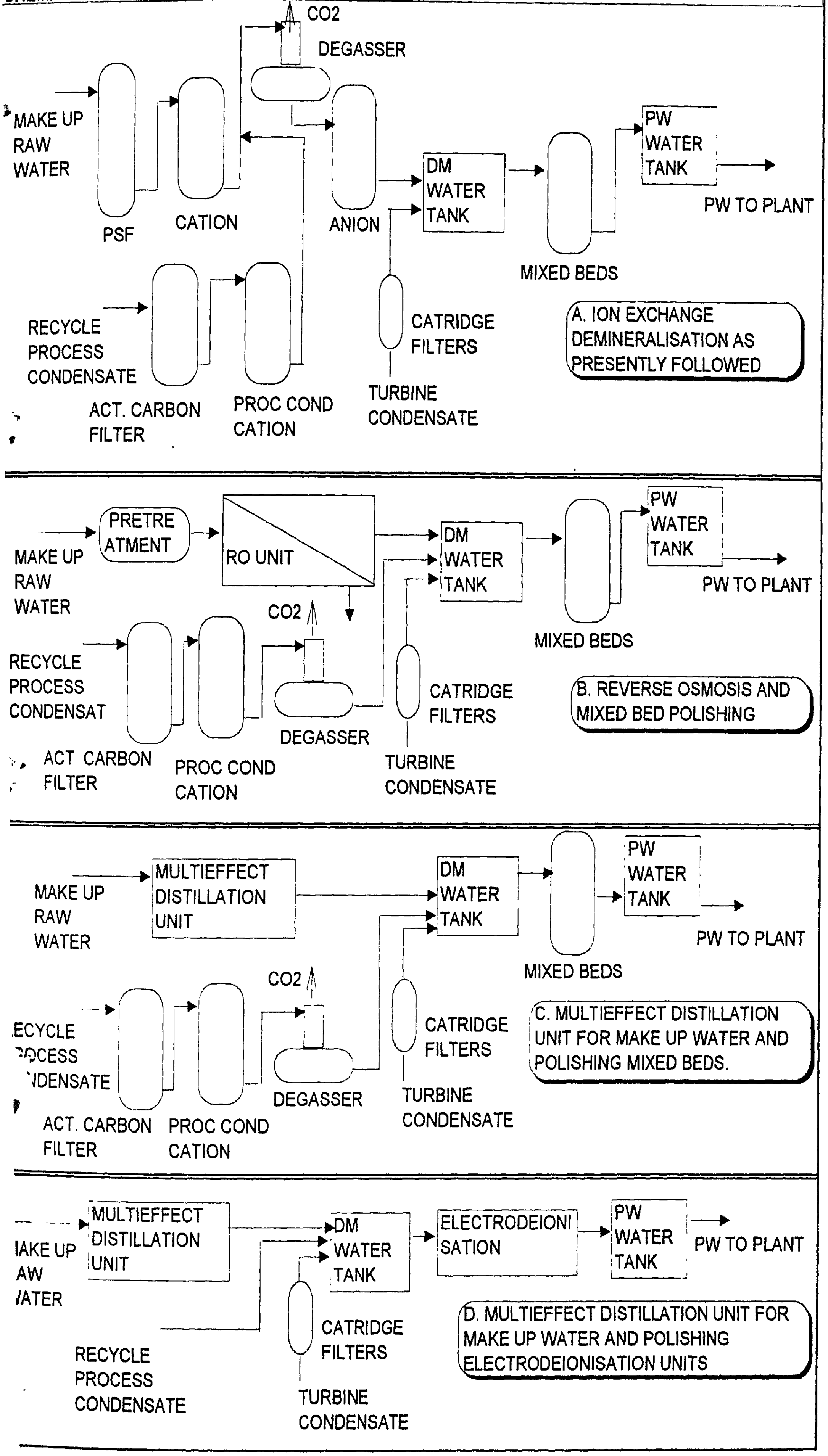
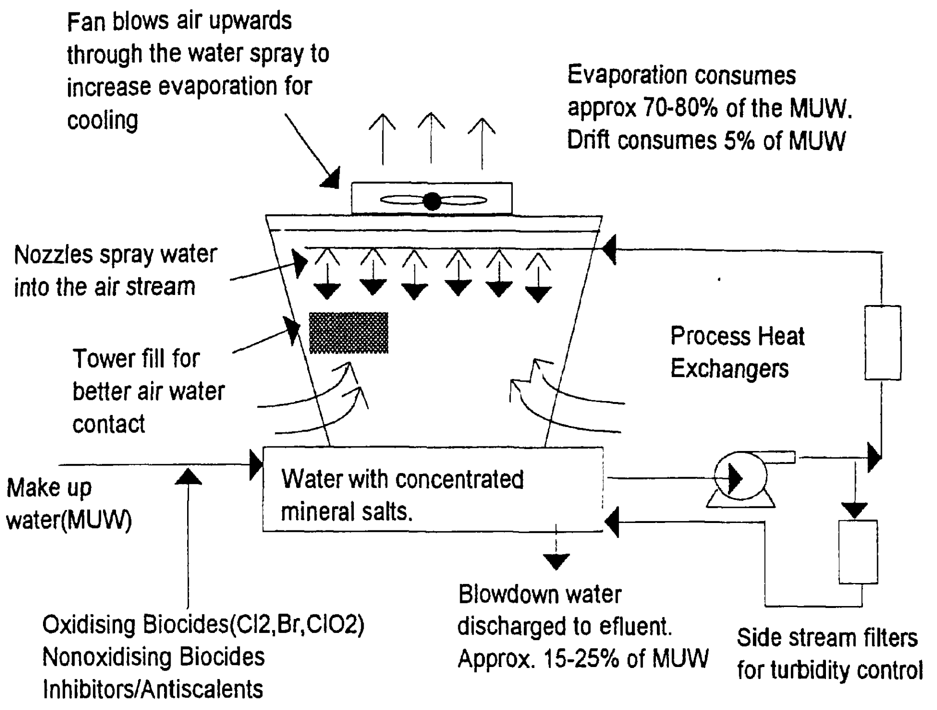
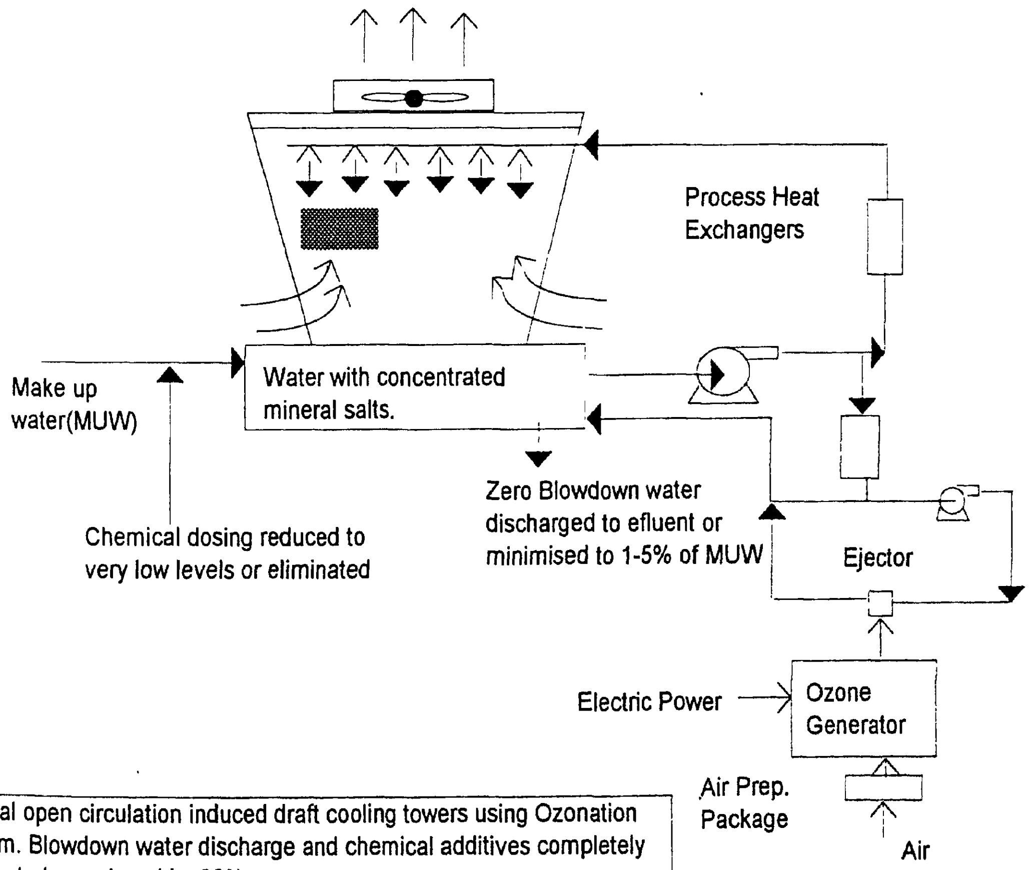


FIGURE- 8 : COOLING TOWER OZONATION SYSTEM


Fan blows air upwards through the water spray to increase evaporation for cooling
Evaporation consumes approx 70-80% of the MUW. Drift consumes 5% of MUW
Nozzles spray water into the air stream
Tower fill for better air water contact
Process Heat Exchangers
Make up water(MUW)
Water with concentrated mineral salts.
Blowdown water discharged to efluent. Approx. 15-25% of MUW
Side stream filters for turbidity control
Oxidising Biocides(Cl2,Br,ClO2)
Nonoxidising Biocides
Inhibitors/Antiscalents

Typical open circulation induced draft cooling towers using a traditional multichemical water treatment program.


Process Heat Exchangers
Make up water(MUW)
Water with concentrated mineral salts.
Zero Blowdown water discharged to efluent or minimised to 1-5% of MUW
Chemical dosing reduced to very low levels or eliminated
Ejector
Electric Power
Ozone Generator
Air Prep. Package
Air

Typical open circulation induced draft cooling towers using Ozonation system. Blowdown water discharge and chemical additives completely eliminated or reduced by 90% or more.

# Programme on Energy, Environment, Resources, and Sustainability (PEERS) - 1997/98

## Final Project Report

April 1998

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Institute for Energy Technology (IFE), Norway
International Institute for Sustainable Development (IISD), Canada

*Supported by:*
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Canadian International Development Agency (CIDA)

# Private participation in Indian coal industry - challenges & opportunities

*Submitted by*
**Mr A Banerji**

# PROJECT REPORT

ON

# "PRIVATE PARTICIPATION IN INDIAN COAL INDUSTRY CHALLENGES & OPPORTUNITIES"

A. Banerji
MINISTRY OF COAL

PROGRAMME

ON

ENERGY, ENVIRONMENT, RESOURCES, AND SUSTAINABILITY (1997-98)

CONDUCTED BY

TATA ENERGY RESEARCH INSTITUTE,
NEW DELHI

# INDEX

| Sl.No. | TOPIC | Page No. |
|---|---|---|
| | | |
| I | EXECUTIVE SUMMARY | I |
| 1 | COAL MINING IN INDIA : THE PAST | 1 |
| 2 | NATIONALISATION OF COAL MINES | 2 |
| 3 | SALIENT FEATURES OF INDIAN COAL RESERVES | 3 |
| 4 | COAL PRODUCTION AND DEMAND | 5 |
| 5 | HOW TO BRIDGE THE GAP | 8 |
| 6 | AMENDMENTS TO COAL MINES (NATIONALISATION ACT), 1973 ALREADY DONE TO FACILITATE CAPTIVE MINING | 11 |
| 7 | IDENTIFICATION OF CAPTIVE COAL MINING BLOCKS | 11 |
| 8 | DIFFICULTIES FELT BY PRIVATE POWER COMPANIES SEEKING TO HAVE CAPTIVE COAL MINES | 12 |
| 9 | 1995-96 GUIDELINES ADOPTED IN MINISTRY OF COAL ON THE PROCEDURAL STEPS FOR CAPTIVE COAL MINING | 12 |
| 10 | BASIC LEGAL FRAMEWORK OF COAL MINING | 14 |
| 11 | SLOW PACE OF CAPTIVE COAL MINING | 15 |
| 12 | OTHER DIFFICULTIES BEING EXPERIENCED IN CAPTIVE COAL MINING | 19 |
| 13 | SUGGESTED SOLUTIONS TO THE DIFFICULTIES BEING FACED BY THE CAPTIVE MINING PARTIES | 22 |
| 14 | CONTRACT LABOUR | 29 |
| 15 | WHETHER AMENDMENT TO COAL BEARING AREAS (ACQUISITION & DEVELOPMENT) ACT, 1957 CAN BE DONE TO ALLOW PRIVATE COMPANIES TO ACQUIRE LAND WITHOUT MINING LEASE | 30 |
| 16&17 | 1997 DECISIONS OF THE CENTRAL GOVERNMENT TO WIDEN THE SCOPE OF PRIVATE PARTICIPATION EXPLORATION AND MINING OF COAL AND LIGNITE | 31 |
| 18 | TWO SCENARIOS | 32 |
| 19 | ADVANCE PLANNING | 33 |
| 20 | FISCAL AND TAX INCENTIVES | 34 |
| 21 | IMMEDIATE TASK - ENCOURAGEMENT TO CAPTIVE MINING | 35 |
| 22 | OTHER OPPORTUNITIES OF PRIVATE PARTICIPATION | 36 |
| 23 | SHOULD THERE BE ANY CARBON TAXATION FOR COAL MINIG IN INDIA | 41 |
| 24 | PRIVATE PARTICIPATION IN INDIAN COAL INDUSTRY - CHALLENGES AND OPPORTUNITIES | 43 |
| 25 | WAYS AND MEANS TO ENCOURAGE PRIVATE SECTOR PARTICIPATION IN COAL INDUSTRY IN INDIA | 48 |

# EXECUTIVE SUMMARY

## SCOPE

In the Project Report, the demand-supply, demand-supply of coal in the country has been analysed to ascertain a realistic gap between the two. While doing so , care has taken to see that the demand for thermal coal is estimated realistically on the basis of actual generating capacity of coal based thermal ower plants in the country and the future prospects of expansion of thermal generating capacity Ministry of Power often exagerates the demand of thermal coal by making a very high projection of installation of additional generating capacity for the thermal power plants. It is a common knowledge that private sector participation in thermal power generation has not met with much success.

## METHODOLOGY

The methodology adopted was basically legal as well as procedural. While on the legal side, amendments have been suggested in the Coal Mines (Nationalisation) Act, 1973 and the Mines and Minerals (Regulation & Development) Act, 1957, procedural side suggestions have been made for introduction of tax and fiscal incentives now granted for the infrastructure industries Though coal mining has not yet been declared as infrastructure industry, a suggestion has been given that the same kind of incentives should be extended to the coal sector also

# Private participation in Indian Coal Industry – challenges and opportunities.

## Coal Mining in India: The past

India has a long history of commercial coal mining covering nearly 220 years starting from 1774 by M/s Sumner and Heatly of East India Company in the Raniganj Coalfield along the Western bank of river Damodar. However, for about a century the growth of Indian coal mining remained sluggish for want of demand but the introduction of steam locomotives in 1853 gave a fillip to it. Within a short span, production rose to an annual average of 1 million tonne (mt) and India could produce 6.12 mts. per year by 1900 and 18 mts per year by 1920. The production got a sudden boost from the First World War but went through a slump in the early thirties. The production reached a level of 29 mts. by 1942 and 30 mts. by 1946.

1.1 With the advent of Independence, the country embarked upon the 5-year development plans. At the beginning of the 1st Plan, annual production went upto 33 mts. During the 1st Plan period itself, the need for increasing coal production efficiently by systematic and scientific development of the coal industry was being felt. Setting up of the National Coal Development Corporation (NCDC), a Government of India Undertaking in 1956 with the collieries owned by the railways as its nucleus was the first major step towards planned development of Indian Coal Industry. Along with the Singareni Collieries Company Ltd. (SCCL) already in operation since 1945 in north eastern Andhra Pradesh, India thus had two Government coal companies. SCCL is now a joint undertaking of Government of Andhra Pradesh and Government of India sharing its equity in 51:49 ratio.

## 2. Nationalisation of Coal Mines

Right from its genesis, the commercial coal mining in modern times in India has been dictated by the needs of the domestic consumption. On account of the growing needs of the steel industry, a thrust had to be given on systematic exploitation of coking coal reserves in Jharia Coalfield. Adequate capital investment to meet the burgeoning energy needs of the country was not forthcoming from the private coal mine owners. Unscientific mining practices adopted by them and poor working conditions of labour in private coal mines became matters of serious concern for the Government. On account of these reasons, the Central Government took a momentous decision to nationalise the coal mines. The nationalisation was done in two phases, the first with the coking coal mines in 1971-72 and then with the non-coking coal mines in 1973. In October, 1971, the Coking Coal Mines (Emergency Provisions) Act, 1971 provided for taking over in public interest of the management of coking coal mines and coke oven plants pending nationalisation. This was followed by the Coking Coal Mines (Nationalisation) Act, 1972 under which 214 coking coal mines other than those with the Tata Iron & Steel Company Limited and Indian Iron & Steel Company Limited, were nationalised on 1.5.1972 and brought under the Bharat Coking Coal Limited (BCCL), a new Central Government Undertaking. Another enactment, namely the Coal Mines (Taking Over of Management) Act, 1973, extended the right of the Government of India to take over the management of 738 coking and non-coking coal mines in seven States including the 214 coking coal mines taken over in 1971. This was followed by the nationalisation of all these mines on 1.5.1973 with the enactment of the Coal Mines (Nationalisation) Act, 1973 which now is the piece of Central legislation determining the eligibility of coal mining in India.

## 2.1 Birth of Coal India Limited (CIL), the Public Sector giant in Indian Coal mining.

As mentioned above, BCCL was set up in 1972 by the Government of India to operate nationalised coking coal mines. The Coal Mines Authority Ltd. (CMAL) was set up in 1973 to operate the nationalised non-coking coal mines. NCDC was brought under CMAL. On 1.11.1975, the nationalised coal industry was again restructured with the establishment of Coal India Limited, a holding company with 5 subsidiaries including BCCL. The other four subsidiaries are Eastern Coalfields Limited (ECL), Central Coalfields Limited (CCL), Western Coalfields Limited (WCL) and Central Mining Planing & Design Institute Limited (CMPDIL), the last one is the subsidiary company of CIL for exploration, mine planning and design as well research. In 1986 two more subsidiaries, namely South Eastern Coalfields Limited (SECI) and Northern Coalfields Limited (NCL) were set up to operate new mines in existence in Madhya pradesh and south-eastern Uttar Pradesh. In 1992, Mahandi Coalfields Limited (MCL), the 8th subsidiary of CIL was set up to operate the Ib-valley and Talcher Coalfields in Orissa. CIL has a small coal producing unit, North Eastern Coalfield (NEC) in Assam. CIL with its present (1996-97) production level of 250 mts. and about 6.5 lakh employees is the largest coal company of the world. Except China, USA and Russia, CIL is ahead of other countries in production.

## 3. Salient features of Indian Coal reserves

About 99% of the country's coal deposits belong to Permian age (about 235-250 million years ago) and the remaining deposits are of Tertiary age (60 million years ago). The Permian coal is a part of Gondwana Formation more or less along the prominent river valleys such as Damodar, Koel, Sone, Mahanadi, Pranhita- Godavari, Kanhan, Pench and Wardha in the States of Bihar, West Bengal, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra and Andhra Pradesh. Tertiary coal occurs in Jammu & Kashmir and the north eastern States of Assam, Arunachal Pradesh and Nagaland.

3.1 As per the estimates of Geological Survey of India (GSI), the total coal reserves of the country as on 1.1.97 down to a depth of 1200 meters are 204 billion tonnes (bts), out of which the proved, indicated and inferred reserves are 72 bts., 90 bts and 42 bts respectively. Out of the total reserves of 204 bts, the non-coking coal and coking coal comprise about 174 bts and 30 bts respectively. The regional exploration is done by the GSI, whereas the promotional drilling for exploration is got done through the GSI and Mineral Exploration Corporation Limited (MECL) with CMPDIL as the nodal agency. MECL is a Central Government Undertaking.

3.2 The salient features of India's coal reserves are:-

i) The non-coking coal reserves accounting to 85.3% of total reserves belong to two categories viz (a) superior with ash and moisture content of less than 29% and (b) high ash coal with ash and moisture content ranging from 29% to 55%.

ii) Coking coal accounting for about 15% of total reserves and occurring in 10 coalfields in Bihar, West Bengal and Madhya Pradesh are of three varieties viz. (a) prime coking which is 18%, (b) medium coking which is 77% and (c) semi-coking which is 5% of the coking coal reserves.

iii) About 63% of total reserves are within a depth of 300 meters and 10% of total reserves are beyond 600 meters depth in deep seams of Jharia and Raniganj Coalfields.

iv) Only 12% of non coking coal reserves belong to higher grade available mostly in Raniganj Coalfield

v) 73% of India's reserves are lower grades of non-coking coal occurring in inter-banded seams of Talcher, Ib-Valley, Singrauli, Rajmahal, North Karampura and Korba coalfields in shallow deposits workable by opencast method.

vi) The high ash coal accounts for about 82% of total non-coking coal reserves.

vii) The eco-friendly features of Indian coal are that its sulphur content is low (mostly less than 1%) the ash fusion temperature is usually high,it is low in chlorene and toxic trace elements and the coal ash has low iron oxide. Only in the Tertiary coal found in small deposits of the north-east, sulphur content is high.

## 4. Coal production and demand

In 1971-72 and 1972-73, the years of nationalisation of coal mines, India produced only 72.06 mts. and 78.17 mts. respectively. In 1996-97, the terminal year of the 8th Plan, India's coal production could reach a level of 288.65 mts. Even the staunch votaries of privatisation of Indian coal industry will agree that the growth in production can be largely attributed to nationalisation. The debatable issue is whether a higher production and higher productivity could have been achieved at lower production cost The production increased from 147.71 mts. in 1984-85 to 238.11 mts. in 1992-93. The rate of growth in the 7th Plan and 8th Plan was 4.8% and 4.7% respectively.

## 4.1 Demand during 8th Plan

Table I below gives the sectoral and total demand of coal in 1992-93 and 1996-97, the initial and terminal years of 8th Plan:-

Table I

(In Million Tonnes)

| Sector | 1992-93 | 1996-97 |
|---|---|---|
| Steel | 32.80 | 41.00 |
| Power | 138.50 | 194.00 |
| Cement | 13.20 | 17.50 |
| Others | 62.80 | 58.50 |
| **Total** | **247.30** | **311.00** |

The 'other' sector includes captive power, sponge iron, fertilisers, brick industry, railways and other consumers.

## 4.2 Future demand

As per the estimates of the Working Group on Coal and Lignite set up by the Planning Commission in the context of 9th Plan (1997-98 to 2001-02) the demand of coal in 2001-02, 2006-07 and 2011-12, the terminal years of the 9th, 10th and 11th Plans respectively will be of the order given in Table 2 below:-

Table 2

(Million Tonnes)

| Sector | 2001-02 | 2006-07 | 2011-12 |
|---|---|---|---|
| Steel | 51.60 | 64.00 | 78.00 |
| Power | 254.80 | 447.00 | 559.00 |
| Cement | 21.40 | 30.00 | 45.00 |
| Other | 77.20 | 112.00 | 153.00 |
| Total | **405.00** | **653.00** | **835.00** |

## 4.3 Future Coal production

Table 3 gives the coal production in 2001-02, 2006-07 and 2011-12 as estimated by the Working Group:-

Table 3

(Million Tonnes)

| Sector | 2001-02 | 2006-07 | 2011-12 |
|---|---|---|---|
| CIL | 303.00 | 372.00 | 522.00 |
| SCCL | 36.00 | 39.00 | 42.50 |
| Other | 7.60 | 7.60 | 7.60 |
| New Captive Coal Companies | 5.75 | 13.00 | 35.00 |
| **Total** | **352.35** | **431.60** | **607.10** |

## 4.4 Demand-Production gap in 1992-93 and 1996-97

The gap between demand and production even after considerable quantity of coal imports in 1992-93 and 1996-97 is given in Table 4 below:-

Table 4

(Million Tonnes)

| | 1992-93 | 1996-97 |
|---|---|---|
| Demand | 247.30 | 311.00 |
| Production | 238.26 | 285.66 |
| Imports | 6.74 | 13.25 |
| **Gap (Production+Imports–Demand** | **2.30** | **12.09** |

## 4.5 Demand-production gap--the future

On the basis of Tables 2 and 3, the demand-production gap in 2001-02, 2006-07 and 2011-12, the terminal years of the 9th, 10th and 11th Plans comes to something like this:-

Table 5

(Million Tonnes)

| | 2001-02 | 2006-07 | 2011-12 |
|---|---|---|---|
| Demand | 405.00 | 653.00 | 853.00 |
| Production | 352.35 | 431.60 | 607.10 |
| Gap | 52.65 | 221.40 | 245.90 |

## 4.6 Gap as percentage of demand

Not only the gap will be galloping in physical terms. its percentage to demand will also accelerate. However, after 2006-07. there may be a slight fall as would be seen from Table 6.

Table 6

(Figs. In million tonnes)

| | 1992-93 | 1996-97 | 2001-02 | 2006-07 | 2011-12 |
|---|---|---|---|---|---|
| Demand | 247.30 | 311.00 | 405.00 | 653.00 | 853.00 |
| Gap | 2.30 | 12.09 | 52.65 | 221.40 | 245.90 |
| % of gap to demand | 0.93% | 3.89% | 13.00% | 33.90% | 28.72% |

Table 6 shows that the situation will became extremely critical in the 10th Plan period. Though in the 11th Plan there may be a slight downward trend, the conclusion is inescapable that during the 10th and 11th Plan periods, India's coal production, about 93 to 96% of which will then also be from the CIL and SCCL, the Government-owned coal companies; will not be able to meet about 30% of the demand. This poses a serious challenge to India's developmental plans. The power sector which consumes about 64% of the coal off-take will be particularly handicapped.

## 5. How to bridge the gap

Currently the steel sector is importing about 10 mts. of coking coal annually. In the 9th Plan, the steel sector proposes to import about 19 mts. per year and therefore a gap of 33 mts. (52-19) will remain in 2001-02. This gap of 33 mts. represents power, cement and other consumers. Presently the demand-production gap is also attributed partly to the imbalance between availability in and demand of the consumers from specific coalfields. In particular, ECL, CCL and MCL have wide shortfalls. The locale-specificity of demand will continue in future also. The consumers obviously prefer lower railway freight and their preference for particular coal grades to suit their fuel needs is also fully justified. Import of coal to bridge a huge gap of 20-30 mts. per year is no solution to the problem. The country can hardly afford to bear such massive foreign exchange outgo and her balance of payments position is not expected to improve so fast. Secondly, most of Indian ports are not capable to handle bulk coal imports of these sizes. Even the capacity of the existing ports of Paradip, Haldia, Vishakhapatnam, Tuticorin and Dahanu is bursting in its seams. Improvement in the infrastructure of Indian ports requires a massive capital investment. Thirdly the high cost of rail transportation is also a deterrent to bring imported coal of these sizes to inland power, steel and cement plants. The Committee on Integrated Coal Policy recommended setting up of power plants at the pitheads but there is no perceptible evidence of significant progress in that direction.

5.1 The budgetary support of the Government to CIL, the public sector giant has been stopped totally since 1996-97. Though on account of deregulation of prices of coking coal and A, B & C grades of non-coking coal in March, 1996 and deregulation of prices of hard coke, soft coke and D grade of non-coking coal in March, 1997, the financial position of CIL has improved, three of its subsidiaries namely ECL, BCCL and CCL have continued to incur huge losses. The total loss incurred by these three companies in 1996-97 is Rs. 689.49 crores (ECL

Rs. 341.16 crores, BCCL Rs. 322.81 crores and CCL Rs. 15.52 crores). BCCL and ECL were referred to the Board of Industrial & Financial Reconstruction (BIFR) as sick industrial companies. On account of an exercise of the internal capital restructuring of CIL, the net equities of BCCL and ECL were revised substantially and their net worth has became positive. BCCL has come out of the purview of BIFR recently but ECL will continue to remain sick as the latter is expected to incur a massive loss of about Rs. 600 crores in 1997-98. BCCL's loss for 1997-98 will be around Rs. 350 crores. High production cost in these three companies on account of surplus labour, high percentage of underground mines, near-exhausted reserves in many of their mines have led to very low productivity as compared to NCL, SECL, WCL and MCL. The latter subsidiaries could notch up high pre-dividend profits in 1996-97 as a result of which the overall pre-dividend profit of CIL in 1996-97 has become Rs. 1137.42 crores. However, so long as the holding-subsidiary structure in CIL remains, the profits from the profit-making subsidiaries cannot be passed on to the loss-making subsidiaries since the mechanism of Coal Price Regulation Account under which the same was being done during the regime of full administered coal prices is now over on account of deregulation of prices of almost all the coal grades. Prices of all coal grades including those of D, E and F grades of non-coking coal (power grade coal) will be deregulated with effect from 1.1.2001 but that also will not give any relief to ECL and BCCL where power grade coal is almost non-existent. Therefore the CIL capacity to make high capital investment to increase production upto 700-800 mts. will remain a dream notwithstanding the expected World Bank loan in the Coal Sector Rehabilitation Project for increasing production in the large 24 opencast coal projects (assortment of mines) of CIL.

## 5. Amendments to Coal Mines (Nationalisation) Act, 1973 already done to facilitate captive mining.

Under the Coal Mines (Nationalisation) Act, 1973 Coal mining was exclusively reserved for the public sector. By an amendment to the Act in 1976, two exceptions to policy were introduced viz.(i) captive mining by private companies engaged in production of iron and steel and (ii) sub-lease for coal mining to private parties in isolated small pockets not amenable to economic development and not requiring rail transport. Considering the need to augment thermal power generation and to create additional thermal power capacity during the VIII Plan period, the Government decided to allow private participation in the power sector. The Coal Mines (Nationalisation) Act, 1973 was amended with effect from 9th June, 1993 to allow coal mining for captive consumption for generation of power, washing of coal obtained from a mine and other end uses to be notified by Government from time to time in addition to the existing provision for captive coal mining for production of iron and steel. The amendment was carried out in Sec. 3(3)(a)(iii) of the 1973 Act by a Gazette Notification dated 9.6.93,Under this amendment, another Gazette Notification has been issued on 15.3.96 to allow production of cement as an end use for captive mining of coal. The June, 1993 amendment to the Act as well as the Gazette Notification of 15.3.96 apply to both the public sector and private sector companies desiring to mine coal for captive consumption. The restriction of captive mining does not apply to the State-owned coal and mineral development Undertakings like CIL, SCCL, Neyveli Lignite Corporation and Mineral Development Corporations of the State Governments.

## 7. Identification of captive coal mining blocks.

Seventy one coal mining blocks with an estimated reserve of 19548 million tonnes, representing about 10% of the nation's reserves as on 1.1.1997 have been identified for captive mining.

## 8. Difficulties felt by private power companies seeking to have captive coal mines.

The power plants require heavy capital investment. Many Indian companies formed joint ventures with the foreign firms. Some private sector power companies expressed inability to do the coal mining on the ground of lack of experience in coal mining. Moreover, they stated that for generation of power, there were guarantee returns on investment and it would not be proper to mix up investments in power generation and coal mining. They, therefore, suggested to set up associated companies for coal mining to mine coal from the captive bocks and supply that coal on exclusive basis to the power companies.

## 9. 1995-96 guidelines adopted in Ministry of Coal on the procedural steps for captive coal mining.

In view of the above-mentioned difficulties experienced by the power generating companies, the legality of a company engaged in power generation, iron and steel production or any of the other end uses notified by the Government of India from time to time, through an associated coal company was examined in Ministry of Coal. in consultation with Ministry of Law and it was decided in 1995-96 to allow coal mining by an associated coal company provided there is a participating interest between the coal company and the end-user company. Captive coal mining can now be done in any of the following three ways:-

i) A company engaged in thermal power generation, iron and steel production, cement production or in any other end uses notified by the Government of India from time to time under section 3(3) (a) (iii) of the Coal Mines (Nationalisation) Act, 1973, can itself mine coal from a captive coal block provided such a company is registered under section 3 of the Companies Act, 1956.

ii) A company engaged in thermal power generation, iron and steel production, cement production or engaged in any other end uses notified by the Government of India from time to time under the above cited section of the Coal Mines (Nationalisation) Act, 1973 can mine coal from a captive block through an associated coal company provided both the end-user company and the associated coal company are formed and registered under section 3 of the Companies Act, 1956 and the end-user company holds at least 26% of voting equity at all times in the associated coal company. The associated coal company is required to be so registered with the objective of supplying coal on exclusive basis to the former company.

iii) There can be a holding company with two subsidiaries i.e. (i) a company engaged in thermal power generation, iron and steel production, cement production or in any of the end uses notified by the Government of India under the above cited section of the Coal Mines (Nationalisation) Act, 1973 and (ii) an associated coal company formed with the objective of mining coal and supplying the coal on exclusive basis from the captive coal block to the former company. The holding company is required to hold at least 26% voting equity in both the end-user company and the coal company at all times. All the three companies should be formed and registered under section 3 of the Companies Act, 1956. The associated coal company is required to be so registered with the objective of supplying coal on exclusive basis to the end-user company.

## 10. Basic legal framework of coal mining.

The basic legal framework of coal mining in India comprises the following:-

i) Eligibility of coal mining is laid down in the Coal Mines (Nationalisation) Act, 1973 which applies mutadis mutandis to lignite mining also.

ii) The leasing provisions both for exploration and mining are there in the Mines and Minerals (Regulation & Development) Act, 1957. This Act also contains provision for payment of dead rent and royalty. Dead Rent is payable from the date of lease to the date of starting coal despatches. Royalty becomes payable from the date of starting coal despatches. The MMRD Act also has the procedure for application of licences for exploration (prospecting) and licences for mining, for determination of leases, termination of prospecting licences and mining licences, etc. The Mineral Concession Rules (MCR), 1960 are the set of rules framed under the MMRD act. The provisions in MMRD Act and MCR apply equally to lignite prospecting and mining.

iii) Pricing, grading and distribution of coal are governed under the Colliery Control Order, 1945 which is continuing under the Essential Commodities Act, 1955. The CCO applies equally to lignite.

iv) Land acquisition is governed by the Land Acquisition Acts of the State Governments. However, CIL has the advantage of land acquisition by notifications issued by the Ministry of Coal under the Coal Bearing Areas (Acquisition & Development) Act, 1957 (CBA Act) without the requirement of applying to the State Government for grant of land acquisition rights as well as coal mining lease for the land to be acquired under the CBA Act, 1957. The private coal companies do not have this facility.

## 11. Slow pace of captive coal mining.

The captive experiment has not met with the expected success. A captive coal mining party is debarred to supply coal to a party other than the end-user (power plant, etc.). India's coal seams are multi-grade and therefore, from a captive block various grades of coal are mined. All these grades are not accepted by the end-user i.e. the thermal power plant or iron and steel plant. Secondly, on account of force-majeure events, the end-user plant may be shut down or may even lower its production thereby affecting its coal intake. In such situation, the captive coal mining party has to accumulate its coal stock which goes on increasing on account of inability to supply coal for any other party. The accumulating stock may cause fire hazards or other environmental problems in addition to causing irreparable financial losses to the coal mining company and wastage of a scarce mineral resource vital for meeting energy demand of the country.

11.1 The internal rate of return (IRR) of the captive coal project is based on a fixed rate of coal despatched to the end user. Since every coal project has to be planned in advance, the IRR of the captive coal project suffers if the coal intake capacity of the end-user goes down. The coal despatches from the captive mine slow down or stop rendering coal project economically unviable. In almost all the cases, the captive coal producer invests funds in his mine partly or fully from the commercial borrowings from domestic or international sources or loans from financial institutions. Repayment of such loans becomes a problem if the coal despatches from his mine slow down or stop.

11.2 The captive coal producers are not directly linked to the SEBs or the power distributors. They are linked to the IPPs or independent power producers. The IPP is required to execute a Power Purchase Agreement (PPA) with a State Electricity Board guaranteeing uninterrupted power supply at a fixed rate for a certain period of years (20 or 30 years) after the PPA is approved by the concerned State Government. The IPP in its turn has to enter into a Coal Sales Agreement (CSA) with the captive coal producing company for a certain period of years (20 or 30 years). The duration of the PPA has to match with the duration of the CSA. The captive coal producer makes an estimate of the gestation period of the coal mine on the expiry of which the commencement of coal supply from the captive mine to the IPP can commence. Similarly the IPP also makes an estimate of the gestation period of his power plant on the expiry of which power generation from his plant can start. The CSA becomes valid from the estimated date of the commencement of coal supply to the IPP and similarly the PPA becomes valid from the date of power supply from the IPP to the SEB. While the IPP becomes committed to purchase all the coal supplied by the captive coal company there can always be a situation caused by force majeure events when the IPP will not be in a position to purchase the committed quantity of coal from the captive coal company. In such a situation, unless the captive coal company is allowed to sell to the SEB that quantity of coal which is not possible to be accepted by the IPP, the guaranteed rate of power supply to the SEB which was committed by the IPP will not be honoured. There are two effects of this situation viz. (a) the IPP becomes liable to liquidated damages payable to the SEB and (b) the captive coal company accumulates coal stock affecting the financial viability of the coal project. For a holding company controlling both the coal company and the IPP, the losses therefore come from these two sources.

11.3 Even in unigrade coal blocks in the country or the blocks which do not have large variety in the coal grades, the quality of coal in all parts of the seam is not uniform. Most of the seams in the captive blocks of Eastern region have this problem of varying quality. Usually, the outcrop region have inferior or weathered quality of coal. The weathered coal in outcrop region is not suitable for use in the power stations. The captive coal producer, therefore, does not have any option but to stock the weathered coal on the surface.

11.4 On account of the restriction on the captive coal producers not to sell to any party other than the IPP, his coal production has to go up and down to match the coal intake capacity of the IPP. Such perfect synchronisation is not possible to be achieved in reality. If the IPP became unable to purchase coal from the coal producer either in full or in part for the force majeure events, the coal company is required to suspend production or despatch of coal from all the seams of his coal mine. In case the production or despatch continues for more than 6 months, the captive coal producer attracts the following liabilities under the Colliery Control Order (CCO), 1945:-

i) Clause 4 (3) of CCO '45 provides that if production or despatch of coal from a seam or seams has stopped for a continuous period of 6 months for any reason whatsoever, the grade fixed (under clause 3 of CCO '45) will be withdrawn. The captive coal producer has to notify the withdrawal of the grade in the manner prescribed by the Coal Controller.

ii) For resuming production from a coal mine or seam or section of a seam wherever the coal production has been continued for a period over six months, the captive producer has to obtain a prior permission from the Central Government in writing as provided in Clause 14 of CCO, '45.

iii) Under Clause 14 A, the captive producer has to give a notice of temporary closure of a coal mine or seam or a section of a seam (for any reason whatsoever) to the Coal Controller within one month of the closure.

The captive coal producer has no exemption from above clauses even if the production or despatch from his mine is suspended on account of the temporary closure of the power plant of the IPP or the inability of the plant to take coal from the captive mine. In other words, the captive coal producer suffers for no fault of his.

11.5 Another factor which was not taken into consideration while proposing the June 1993 amendment to the Nationalisation Act is what a captive coal producer will do with other materials coming out from the coal seams. The shale bands and carboneceous shales in the seams occur frequently during the blasting operations in opencast mines. These shale bands get mixed up with coal and affects the coal quality. The captive coal producer has to stock the mixed up coal separately. He cannot supply the mixed up coal to the power plant. It is to be kept in mind that the end user power plant is much more selective in the quality of coal coming from the captive mine. The State Electricity Boards (SEBs) getting coal from the CIL collieries do not exercise such strict vigil since the SEBs receive much larger consignments every day and from a variety of coal mines. The SEBs also have the opportunity to get CIL coal on credit. The mixed up coal lying on the surface of captive blocks is exposed to further weathering due to heat and rains. It is necessary that the captive coal producer finds a market for the weathered coal (bhus). On account of exposure to heat and rain, the weathered coal can catch fire and thereby endanger the mining operations as well as the environment. Stock piling of coal as well as the mixed up coal causes air and water pollution also. There is another material usually called Jhama or burnt-up coal (burning by natural process) which is extracted along with coal. The captive coal producer is saddled with this material also which obviously will not be accepted by the end-user power plant.

## 12. Other difficulties being experienced in captive coal mining.

The other difficulties being experienced by the captive coal mining parties are:-

i) A captive producer has to depend on the railways for railway siding and wagons for coal transportation. The railways charge the cost for providing the sidings. While there is full justification for charging the cost of wagons for transportation of coal, the railways should bear the cost of sidings. On account of the delay in providing the sidings and wagons, Ministry of Coal is not able to grant him timely linkage for power grade and cement grade coal and Ministry of Steel for steel grade coal. Without the linkage, no coal transportation is possible since this linkage has to be given with the concurrence of the railways.

ii) Land acquisition by a captive coal mining party for operating the opencast mines is a costly and time consuming process. Generally it takes 4-5 years for acquisition of land for the coal mine. It is understood that some of the State Governments have drawn up a well-laid Land Acquisition Plan which, if implemented, can make the entire land available within a period of maximum two years. The captive mining parties are often faced with the problem in working out a compensation package for the land to be acquired which is acceptable to the State Government. They also face a problem of payment of the compensation package as decided by the State Government Authority. On many occasions, the parties to be affected or the would be land-losers do not come up for receiving of such compensation, on account of absence of job assurances. Though providing jobs to the land oustees is a socio-political requirement, the same should not be linked to physical possession of the land. The coal companies can provide jobs to the extent the jobs are available within the land-area acquired for mining and they cannot go beyond that extent. Moreover, the opportunity for providing job to the coal land oustees should be given only when the coal mine starts operation. Providing the employment and physical possession of the land should not be done simultaneously. The displaced persons with required skill (after proper vocational training) can only be absorbed if the jobs are available for them. Alternatively, the land oustees can be encouraged in schemes of self-employment in the area. While the CIL has the advantage of land acquisition by notifications issued by Ministry of Coal under the Coal Bearing Areas (Acquisition & Development) Act, 1957 (CBA Act) without the requirement of applying to the State Government for grant of land acquisition as well as coal mining lease for the land to be acquired under the CBA Act, 1957, the captive coal mining parties do not enjoy this privilege.

iii) They are not usually able to meet the debt-equity norms laid down by the financial institutions at the time of considering their loan applications. Since the coal mining leases are not assignable, the financial institutions cannot allow transfer or assignment of coal mining leases to another party if the original lessee is not able to repay the loan to the financial institutions.

iv) All the captive blocks being offered are not of right economics of scale. Many of the blocks do not have the sufficient reserves to support power generation or iron & steel production in big plants for 20-30 years. Some of the blocks are not even virgin.

v) The captive coal mining parties have to go through a plethora of clearances like land acquisition, forestry clearance, environmental clearance, getting the persons nominated (by the captive coal mining party) to prepare the mining plan recognised by Ministry of Coal under Mineral Concession Rules, 1960 (MCR '60), getting the mining plan approved by Ministry of Coal under MCR '60 or MMRD Act '57, obtaining previous approval of Central Government u/s 5 (1) of MMRD Act by Ministry of Coal before grant of lease and lastly grant of mining lease by the State Government. For a company or a holding company managing both an IPP and a captive coal company, the problem of going through the various Departments of the Central Government and State Government for these clearances is extremely acute. The procedural labyrinth in these Departments and their lack of basic knowledge to appreciate the technical and financial realities are awesome. When the IPP goes to negotiate a PPA with a SEB, it has to explain to the SEB on what constitutes a bankable document despite the fact that the Ministry of Power has issued necessary guidelines to the SEBs in this regard. The IPP has also to explain to the Financial Institutions the requirements for arriving at financial closure and a balanced Fuel Supply Agreement. The railways have to be explained the coal transportation needs and thereafter the financial institutions are required to be satisfied about the Internal Rate of Return before the IPP or the coal company can get the funding. Lastly, the various departments of the State Governments are to be satisfied about the forestry clearance and the justification for recommending environmental clearance for the Ministry of Environment & Forests of the Central Government. Another department of the State Government has to be educated about the necessity of expeditious grant of coal mining lease. Apart from lack of knowledge, there is lack of empathy. The indifference in Government departments coupled with total absence of communication between different departments of the Central Government and State Government have caused considerable financial losses to the captive parties. Since money has a time-value, substantial losses have to be borne by the private parties on account of escalation of project cost.

vi) No mechanism or formula to determine the transfer price of coal to be supplied from the captive mine to the end-user exists as on date.

vii) The captive mining parties are required to purchase Geological Reports for the captive block from CIL at a heavy price. They do not usually have the option to carry on with their own exploration at a lower cost before preparing the mining plan.

13. **Suggested solutions to the difficulties being faced by the captive mining parties.**

13.1 Captive mining parties may be allowed to supply coal to a party other than the linked end-user under certain conditions.

13.1.1 Section 3 of the Coal Mines (Nationalisation) Act, 1973 prescribes only the eligibility of coal mining. Sale or distribution of coal do not find any place in the Nationalisation Act. The words "captive consumption" are not appearing in the Act itself though the words "end use" are present in section 3. The Act is silent about sale or distribution of coal. On account of these reasons, supply or sale of coal by a captive producer to a party other than the linked end-user does not seem to violate the provisions of the Nationalisation Act..

13.1.2 Coal is an essential commodity. Despite the recent Government decisions in February, 1996 and February, 1997 to deregulate the pricing and distribution of coking coal and A, B, C & D grades of non-coking coal and Hard Coke and Soft Coke in two phases, coal has remained an essential commodity and therefore, the powers that the Central Govt. derives from the CCO '45 in regard to distribution of coal have been left undisturbed even after the 1996-97 amendments to the CCO '45 to give effect to Govt. decisions regarding phased deregulation of pricing and distribution of coal. Under Clause 8 of CCO, '45, the Central Government is empowered to give directions to any colliery owner regarding the disposal of the stocks of coal or of the expected output of coal during any period to any person or class or description of persons or the order of priority in such disposal. Clause 12(C) of CCO, '45 empowers the Central Government to direct a person (who was allotted coal under the CCO) to deliver coal to another person if the Central Government is satisfied that the former person does not require the whole quantity of coal or any part thereof.

13.1.3 It is suggested that under the powers vested by CCO '45 the Ministry of Coal may allow a captive coal mining party which has been allotted coal block for power generation, to sell that quantity of coal to a SEB and any other power plant which the IPP with which it was originally linked does not require. The provision to supply coal to the SEB should extend for a period for which the IPP's inability extends provided that the IPP has communicated the quantity and period in writing to the captive coal mining party and to the Ministry of Coal and that the terms of supply of coal have been settled between the SEB or the other power plant on one hand and the captive coal mining party on the other.

13.1.4 Subject to the written inability of the IPP being received in the Ministry of Coal that it does not require particular grade(s) of coal mined from the captive block, the Ministry of Coal may allow the captive coal producer to sell coal to any party identified by the Ministry at a price fixed by the nationalised coal companies for the particular grade(s).

13.1.5 Subject to a certificate from the Coal Controller after inspection of the captive mine that the mine is producing substantial non-coal material like weathered coal or burnt-up coal which is not accepted by the IPP, Ministry of Coal may allow the captive coal mining party to sell the non-coal material to the open market.

13.1.6.The above proposals should apply mutadis mutandis to the captive coal mining parties allotted coal blocks for captive consumption in iron and steel production or cement production or any other end use notified by the Central Government from time to time under section 3(3)(a)(iii)(4) of the Nationalisation Act.

### 13.2 Other solutions to their difficulties

The other solutions that may be considered to ease the difficulties of captive mining parties are:-

i) The captive coal mining parties may be allowed railway sidings either free of cost or on payment of an advance adjustable against the railway freight within a fixed number of years. As an alternative the private parties should be given land free of cost to set up their own sidings to carry coal to the nearest existing siding.

ii) The proposal given in para No. 12 (ii) above for encouraging the land oustees in schemes of self-employment by giving them vocational training may be considered. The funds available under the Central Government schemes of vocational education may be provided for this purpose. A suitable compensation package can also be worked with the help of the State Government on year to year basis under which the deemed earnings from the acquired land for a certain number of years can be given to the affected families. The finalisation of the plans for rehabilitation and resettlement should not come in the way of land acquisition

iii) There is another alternative. On payment of appropriate costs, the captive coal mining company may be freed of the objection to locate and provide land for compensatory afforestation.

iv) Forest clearances may be obtained by the Ministry of Coal before allotment of the captive blocks.

v) For preparation of mining plans, the captive coal mining parties may have the option of either purchasing the geological report (GR) from CIL or doing the exploration themselves. If they opt for the second route preliminary geological data about the block may be given to them on a minimal cost.

vi) The reserves below the ground cannot be shifted elsewhere Still the mine developers require site clearances before starting mining operations. Site clearances for coal projects are not necessary The industrial sites (factories, etc ) above the ground can be shifted but geological reserves below the ground cannot be shifted.

vii) The captive blocks allocated should be of right economies of scale, having preferably at least 50-60 million tonnes of proven reserves to sustain power stations of 500 MW generation to operate for 25-30 years at a plant load factor of 80-85%.

viii) For the IPPs, Ministry of Power has a policy of certain plant-load factor and several incentives A similar set of incentives for the captive coal mining parties may be introduced so that they can be encouraged to start coal production quickly and improve productivity. A set of guidelines for determining the transfer price of coal supplied by a captive coal company to the end-user company, particularly an IPP should be laid down after carefully determining the criteria of production cost in captive mines..

ix) Setting up of a power plant becomes certain at the time of its financial closure. At that time the captive coal mining company becomes convinced that his block can supply coal to the power plant. Since procurement of Geological Report (GR) for exploration in the coal mine at the time of financial closure of the power plant causes substantial delay, the GR should be made available to the captive coal company immediately after block allocation. By the time the PPA is signed with the concerned SEB and the IPP is close to financial closure, the environmental clearance, land acquisition, etc. should be achieved synchronising the schedules of the power plant and the coal mine. A specific time limit should be laid down for considering all types of clearances like land acquisition, forestry clearance, environmental clearance, approval of mining plan, finalisation of FSA and PPA, grant of linkages by the Ministry of Coal or Steel as the case may be in consultation with the railways and availability of loans from financial institutions. This time frame should be enforced in all the concerned departments of the

Central and State Governments as well as in the financial institutions. They should take decisions on the applications either by accepting the request or rejecting them within the time frame. Adequate transparency should be enforced in the instructions giving the time frame so that the coal mining party or the IPP is made aware of the reasons for rejection of their applications. It is suggested that each of the departments should be given a time of maximum three months to decide on the various applications. The time-limit should be enforced rigidly and the Government departments made accountable for delays. However, on account of the variety of departments and their control coming under the Central and State Governments, a Single Window Clearance is not feasible.

x) There should be an integrated approach for the coal project, the power project and the transmission project so that at the time a particular project conceives, the synchronisation of the input-output relationship becomes well-established. These three projects being inter-dependent to each other, non-viability of one affects viability of the other two. Liquidated Damage (LD) is not a key to the success since all the three projects are usually financed by the FIs or banks and LD comes into the picture only in non-performance.

xi) Coal mining by itself may be treated as a business. Tagging on coal mining with power generation or any other business will not make it bankable by itself. The parties should seek financial viability of coal mining of a block exclusively and should not link it up with the power project.

xii) If a fixed price between a coal producer and power purchaser is agreed upon, the efficiency factor cannot be looked into judiciously. The financiers to the coal project are different from the financers to the power project. The lenders to the coal project have their structures different from the structures of the lenders to the power project. Therefore, these two projects should be separated while submitting their financial viability before the financial institutions. There is no reason as to why the coal project by itself cannot be bankable provided that the size of the mine satisfies economies of scale and the coal company is permitted to sell coal in the market.

xiii) The cost of incidental infrastructure like rail tracks and roads may be included in the cost of the coal project instead of leaving the responsibility of infrastructure development to the Government. The inclusion will help the FI to evaluate the viability of the coal project not only from the angle of per tonne extraction of coal but also from the angle of ability to supply coal to the end-users or other consumers permitted by the Central Government. The only income for the coal company being the proceeds from coal sales, the ability to supply coal to the consumers in right time and in right quality is a vital factor to evaluate financial viability of the coal project. Development of infrastructure by the Government is not only time consuming but also an uncertain determinant for the evaluation. It is hardly possible for the financial institutions to anticipate how soon the infrastructure would be developed by the Government or whether that infrastructure would be able to achieve movement of coal projected by the coal promoter.

xiv) Within a period of 7 to 8 years of necessary clearances from the Government, the loan is required to be paid up. During this tenure of the loan, adequate cash flows should continue so that repayment of loan is possible. In case the captive coal company is not able to perform during the tenure of the loan, the lenders should have the option to replace the company with a more efficient company so that the loan can be recovered. Transfer of lease or land provides the mechanics. The key is the ability of the financial institutions to control the management of captive coal company and replace it by another management in which they have the confidence that the new management will be able to repay the loan. If this can be ensured, the financial institutions or Banks will not have any problem of lending the resources. Otherwise in the event of non-performance of the block allottee, the financial institutions have to go back to the Ministry of Coal to find out a suitable party who can be given the same block and that is a time consuming and non-lendable proposition.

## 14. Contract Labour

The Committee on Integrated Coal Policy recommended amendment in the Contract Labour (Regulation & Abolition) Act, 1970 to allow engagement of contract labour in coal mines. However, this recommendation has not been accepted by the Central Government. The Act does not allow engagement of contract labour in any operations which go on 12 months round the year. Since work in coal mines is not seasonal, the recommendation does not seem to receive legislative approval. There is a demand from the captive coal mining parties for exemption from this Act. It is not feasible to have two different sets of arrangement for coal labour in nationalised companies and private coal mining companies.

## 15. Whether amendment to Coal Bearing Areas (Acquisition & Development) Act, 1957 can be done to allow private companies to acquireland without mining lease?

CIL has a tremendous edge over the private coal companies by way of acquisition of land for coal mining through Central Government notifications issued under the Coal Bearing Areas (Acquisition & Development) Act (CBA Act), 1957 without their land acquisition and mining lease applications granted by the State Government. Since the land is acquired by CIL by such a notification under CBA Act it does not require even a mining lease from the State Governments. This piece of Central legislation was enacted in 1957 'to establish in the economic interest of India greater public control over the coal mining industry and its development by providing for the acquisition by the State of the worked land containing or likely to contain coal deposits or of rights in or over such land '. It seems that the intention of the 1957 enactment was to help NCDC (set up in 1956) to expand quickly by acquiring land for coal mining fast. While the Nationalisation Act of 1971-73 helped CIL to take over almost all the private coal mines of the country then existing, the CBA Act has helped CIL to acquire lands for new coal mines. This process is continuing and will continue. The demand from the private sector to extend this facility to private coal mining companies on the ground of equity is not unjustified. However, the State Governments are not likely to agree to surrender their powers of granting land acquisition rights and coal mining leases to the private parties. The situation in the mid-fifties dominated by private coal mines was different unscientific mining, labour exploitation, environmental hazards, lack of capital investments. Moreover many of the State Governments have their own Mineral Development Corporations and a few of them in Bihar, Gujarat and Rajasthan have already started coal and lignite mining. The State Governments may have a counter claim that the CBA facility should be extended to their undertakings rather than to the private sector. Given the present surge of federalism in India, it is doubtful whether a Bill for amendment to the CBA Act to extend the CIL facility to private sector in coal mining will receive legislative approval in the Parliament

## 16. 1997 decisions of the Central Government to widen the scope of private participation in exploration and mining of coal and lignite.

Keeping in view the recommendation of the Committee on Integrated Coal Policy, the Central Government took the following decisions subject to legislative approvals in the Parliament:-

i) Amendment to Section 3 of the Coal Mines (Nationalisation) Act, 1973 to allow commercial coal mining by all Indian Companies to mine coal and lignite without the existing restriction of captive consumption.

ii) Setting up of an independent body to monitor allotment of blocks for exploration of coal and lignite after selection on the basis of competitive bidding and framing of a new Act on the lines of Mines & Minerals (Regulation & Development) Act, 1957 to provide for the powers and functions of the independent body while retaining the provisions of the MMRD Act.

16.1 On the basis of a recommendation of the Committee on Integrated Coal Policy, the Central Government also decided in 1997 to set up a Regulatory Body to perform the appellate function in resolving the price disputes between the coal and lignite producers and consumers and to allow establishment of this body by a notification under the Colliery Control Order, 1945.

17. The Bills for amendment to the Nationalisation Act and framing of the new Act mentioned in para 16 above are yet to be introduced in the Parliament It is understood that the labour unions in the coal industry are not agreeable to these policy changes. Since the step to set up a Regulatory Body to adjudicate on the appeals related to coal price disputes can be taken only after the proposed amendment to this Coal Mines (Nationalisation) Act, 1973 , the action to set up the Regulatory Body is also held up

## 18. Two Scenarios

We have two scenarios before us viz. (i) pre-policy change scenario and (ii) put policy change scenario. The second scenario is uncertain. It is difficult to anticipate at this stage whether the Bills will be introduced in the Parliament and whether they will receive legislative approvals in the Parliament after their introduction. The first scenario is clear since it is a reality since June, 1993. Even if the Bills receive legislative approvals. there will a long time before the necessary rules and regulations under the second Act i.e. the proposed new Act for regulation and development of coal and lignite can be framed on the lines of the Mineral Concession Rules, 1960 and a Bill to frame such rules receive legislative approval in the Parliament. The new Bill for framing a new set of MCR for coal and lignite in the post-policy change scenario should provide in addition to the broad framework of the process of competitive bidding. the selection criteria and conservation and inspection aspects. A set of regulations specifying the procedure for filing applications and the terms and conditions of service of the members of the Independent Body will also require to be framed. All these would require time. After the legal and procedural framework is adopted. the actual process of competitive bidding to select suitable parties for allotment of coal and lignite blocks for exploration and mining would take time to crystallize. In coal industry there is no precedent for this. While it is understood that the criteria and the broad framework have already been drawn up, the setting up of the Independent Body and initiation of the process of competitive bidding require careful advance planning. There is a suggestion that India should draw upon the UK experience in privatisation of coal industry. There is a very wide difference between the UK privatisation and what has been decided by the Government of India. The decision of the Government of India is not to privatise the entire coal industry. None of the working coal mines of CIL and SCCL and the lignite mines of Neyveli Lignite Corporation would be privatised. None of the coal and lignite mines presently being operated by the State Government Minerla Development Undertakings would also be privatised. Lastly, all the nationalised coal and lignite companies, the GSI as well as the State Government Undertakings engaged in exploration and mining of coal and lignite will also participate in the competitive bidding process. Perhaps there is no parallel to this sort of change in coal industry anywhere in the world where not only the existing rights of State-owned companies and bodies will remain intact, they will have the same rights as the private sector in exploration and mining in new blocks. Even this limited entry of private sector is being opposed by the trade unions.

## 19 Advance Planning

New difficulties are being experienced in private power generation since entry of private sector in power generation was started without adequate and careful advance planning. In order to avoid similar predicament in coal industry, advance planning of all the necessary steps to widen the scope of private participation should be made. Such advance planning should, inter-alia, cover the following:-

i) The issues of risk mitigation, capital costs and capital restructuring.

ii) Infrastructure planning including the rail transportation planning by locating the possible coal deposits and location of power, steel and cement plants.

iii) Various contracts to be executed with the exploration parties, the coal and lignite mining companies and the force-majeure provisions in such contracts.

iv) A new set of regulatory framework in coal industry identifying the relaxation in mineral and environmental laws and procedures and providing for conservation, safety and development of coal and lignite reserves.

19.1 Privatisation of coal industry in UK took off after a series of studies, reviews of regulatory framework and advance planning. The UK goal was more simplistic than what is being planned in Indian coal industry. The experiment in India where public sector and private sector will participate together keeping the dominant role of public sector intact, is a complex arrangement.

## 20 Fiscal and Tax incentives

Several industries including Power, Roads, etc. have been given the status of infrastructure industries in the Finance Bill of 1997. Unfortunately, 'coal and lignite' have not been declared as infrastructure though about 70% of the power generation of the country is coal and lignite based. However, the fiscal and other tax incentives that are available with the infrastructure industries should be made extended to coal and lignite mining also. Some of such major incentives are:-

i) Exemption from payment of minimum alternative tax of 30% of the adjusted book profits of a coal company whose taxable profits is less than 30% of the book profits.

ii) Full tax exemption for the first 5 years u/s 80-IA of the Income Tax Act.

iii) Tax exemption U/S 88 of Income Tax Act in respect of investments in debentures and equity shares offered by the coal companies.

iv) Income tax exemption on limited income or long term capital gains.

v) Income tax exemption upto 40% of the profit made by the financial institutions making investment isn the coal and lignite projects.

vi) 20% tax rebate for investment in shares, debentures and the bonds of the coal companies

vii) Permission to the foreign institutional investors to invest in unlisted Indian coal companies.

viii) Permission to the coal projects to avail of external commercial borrowing to the extend of 50% of the total project cost.

ix) Provisions to import capital goods required for coal and lignite projects at zero import duty, so that capital expenditure in acquisition of imported equipments in such projects is reduced.

### 21 Immediate task—encouragement to captive mining.

Since the first scenario of captive mining is a reality, the steps suggested in paras 13, 13.1 and 20 above may be considered to encourage the private participation in coal and lignite mining for captive consumption.

## 22. Other opportunities of private participation

### 22.1 Lignite mining

Commonly known as 'Brown Coal', lignite is a fossil fuel belonging to the Miocene Age (25 million years ago). The colour of lignite is tan brown and it is brittle to handle. Lignite is born of vegetable matter having undergone bio-chemical decay to the stage of peat (rotten wood) and then metamorphosed to lignite under the pressure of the soil above through floods, movements of the earth's crust and dehydration.. It is a low calorific fossil fuel. Because of its high moisture content, oxidisation in lignite starts quickly in open air contact and it catches fire. Though oxidisation can be avoided by drying the lignite, the drying process is very costly and unviable. Since lignite cannot be transported and have to be used internally, the power plant is required to be erected at the pit head only.

22.1.1 The legal framework of coal mining applies mutadis mutandis to lignite also. In other words, the June, 1993 amendment to Coal Mines (Nationalisation) Act, 1973 to allow coal mining for captive consumption in power generation and the 1995-96 guidelines mentioned in para 9 above to allow captive coal mining through associated coal companies apply to lignite mining also.

22.1.2 The State-wise break-up of lignite reserves in India is given below.-

(Million tonnes)

| State | Geological reserves of lignite |
|---|---|
| Tamil Nadu | 21806.26 |
| Rajasthan | 1430.94 |
| Gujarat | 932.35 |
| Jammu & Kashmir | 127.84 |
| Kerala | 108.30 |
| Total | 24405.69 |

22.1.3 Out of 21806.26 million tonnes of Tamil Nadu reserves, only 3300 million tonnes are within the leasehold areas of Neyveli Lignite Corporation (NLC), a Central Government Undertaking. Lignite mining in Gujarat and Rajasthan respectively is being done by Gujarat Mineral Development Corporation and Rajasthan Mineral Development Corporation, both State Government Undertakings. The lignite reserves in these two States have mostly been earmarked respectively to these two State Undertakings. The total lignite reserves with the public sector is only 5663.29 mts. (3300+1430.94+932.35) and therefore the remaining 77% of the lignite reserves are available for mining by the private sector.

22.1.4 Tata Energy Research Institute (TERI) was contracted in 1987 by the NLC to study the various energy options in the Southern region of the country. Apart from the north eastern part of Andhra Pradesh, the rest of the Southern India is totally devoid of coal reserves. After comparing the various options such as hydropower, nuclear power and coal-based thermal power, the TERI study came to the conclusion that lignite based power generation is the best economic option in Southern India. The study also identified the following advanges in using lignite as a fuel for power generation.

(a) Availability of adequate reserves of lignite of consistent quality.

(b) Advantage of lignite-fired boilers is more than coal-fired boilers since the ash content of lignite is very low (7%) compared to coal (40%). Lignite ash is also less corrosive and abrasive.

(c) Owing to low ash content, the land requirement for ash dump is also lower compared to the ash dump area needed for coal-fired boilers.

22.1.5 Coal deposits are far away from the industrial centers of Tamil Nadu, Karnataka, Kerala, Rajasthan and Gujarat and therefore the cost of coal transportation to these States is high. Apart from Kerala and Gujarat (where Narmada Valley Project is coming up), the hydro-power potential in rest of such States is negligible. They do not have big rivers. The hydro potential of Cauvery river has already been exploited. As such the lignite reserves in these States particularly in Tamil Nadu can be used for power generation as well as for meeting the demand for other industries such as cement, textiles and chemicals where coal is being used now.

## 22.2 Coal Bed Methane

Coal is a major source of hydrocarbons, particularly the natural gas which is a product of the coalification process. Significant exploration for coal production of Coal Bed Methane (CBM) began in USA around the mid-1980s. Currently exploration and production is being done in Australia, Canada, China, Czech Republic, Russia, Poland, South Africa, Spain and UK. Most of the CBM used throughout the world probably comes from operating longwall mines which practise machine drainage techniques to control gas in the underground environment. The CBM thus produced is used at a surface plant to provide hot water or electricity or sold to a nearby industry as a low grade heating fuel. The advantages of CBM utilisation are:-

i) Reduction of limitations to coal production attributable to gas emission
ii) Safer working conditions due to a higher standard of methane control
iii) Cost savings due to the availability of an on-site energy supply
iv) Revenue from exported energy (gas or electricity)
v) Savings on ventilation costs as the need for dilution of gas in the airways is reduced

22.2.1 The favourable condition for occurrence of CBM in India appears to be limited to areas where bituminous coal with virtrinite reflective value of 0.7 to 1.7% occurs within the depth range of 300 to 1200 metres. The coal reserves of such type are about 29 billion tonnes and are mostly located in Damodar valey coalfields of Raniganj, Jharia, West Bengal, East Bokaro, North Karanpura and South Karanpura as well as in the Godavari Valley. Taken together the CBM potential in these coalfields appears to be about 471 billion tonnes. The Ministry of Petroleum & Natural Gas has been assigned the work of CBM projects. The major issues that need consideration by CBM projects are:-

i) **Marketing and distribution:** A market for CBM has to be established. Construction of hundreds of KMs of pipeline connected to the CBM producing fields to the gas markets is essential.

ii) **Tax incentives:** The US developers of CBM enjoy incentives under the tax groups. The same kind of facility should be available to India also in order to counter the risk of CBM production.

iii) **Legal issues:** It is to be sorted out whether the rights for coal and CBM should be separately held The alternative is to pay a certain amount of money to the coal company in order to get its permission to drill the pipeline to extract CBM. In that case, the lessee of the coal mine will grant a lease or enter into some other agreement with the CBM producer.

## 22.3. Other areas of investment

Some other areas of investment opportunities in the coal industry are:-

i) The coal production particularly in the opencast mines require a very large number of equipments and spares. Investment in companies to manufacture HEMMs and spares will be worthwhile.

ii) Investment in construction of roads (both approach and arterial) is essential for meaningful development of coal mines. The companies making such investment can earn profits through toll collections. Road construction has already been declared as an infrastructure industry and therefore it enjoys all the incentives available for the infrastructure industries.

iii) There is very good scope of investment opportunities in construction of housing colonies in coalfields peripheries.

iv) Investment in workshops for repair or overall HEMMs will be quite profitable.

v) Investment opportunities existing in environmental sector should be utilised for the right growth of coal industry. Such investment may be used in plantations, compulsory afforestations, restoration of original land use, introduction of air and water pollution control measures and rehabilitation of displaced persons.

vi) The rejects after washing of coal can be used for power generation in Fluidized Bed Boilers (FBB) for the power requirement in the coal mines.

vii) Indian non-coking coal is very high in ash content and therefore it is necessary to encourage echo-friendly utilisation of coal ash projects in manufacture of fly ash bricks, etc. The captive cost of the coal ash projects can be included in the overall project cost of the power plant. Alternatively, the IPPs can sell the fly ash to other companies for production of fly ash bricks.

## 23. Should there be any carbon taxation for coal mining in India.

A recent World Development Report (1996) has concluded that India's percapita energy use is only 243 Kilograms of oil equivalent (Kgoe). Per capita energy consumption in China, Indonesia and Brzail is 647 Kgoe, 393 Kgoe and 691 Kgoe respectively whereas the per capita energy consumption in USA as high as 7905 Kgoe. In Canada this figure is 7795 kgoe. The same report says that India emits roughly 770 million metric tonnes of carbon dioxide which is only 4% of global carbon dioxide emissions. On a per capita basis, India's carbon dioxide emission is about 0.9 metric tons, compared with 12 metric tons in high income countries and 19 metric tons in the United States. The central problem of India's economic development is that half of her vast population is either unemployed or employed in marginally productive jobs. Naturally, the per capital net resource creation in India is very low despite the high savings rate. Obviously the carbon dioxide limitation options that are desirable in India are different from global warming abatement. These are (i) afforestation, (ii) plantation (iii) efficiency enhancement and (iv) deployment of renewable energy technology. Because of the vast population of the country and the energy needs for her developing economy, the national priority in India is development for resource creation and employment generation. Naturally global warming is a low priority issue in India. This issue has generated some debate in the country only because of the international debate in global warming. It would be unfair to single out coal production as the principal factor responsible for carbon dioxide emission. The fact that the environmental hazard caused by coal based thermal power plants is much more than coal mining should be taken into account.

23.1 Even going by the country-wise carbon emission levels, India is almost at the bottom of the ladder; her emission level is 21 times less than the USA's. In such a scenario, is there a case for introduction of carbon taxation in India before she can feed her teeming population, house them and provide them minimum education so that they can face the world of work with confidence? At a time when this country is groping for ways and means to attract private investment in exploration and mining of coal and lignite, imposition of carbon taxation in the coal industry will be a serious disincentive, particularly when no such taxes are imposed in any other industry of the country. Coal should not be singled out as the principal polluter when the other polluting industries particularly the thermal power generation have not been subjected to carbon taxes. The private parties keen to make investment in exploration and mining of coal and lignite should not be put off by a threat of carbon taxes at this stage when a national policy of carbon taxation in India has not been adopted.

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# Programme on Energy, Environment, Resources and Sustainability (PEERS) - 1997/98

## Final Project Report

# Review of energy policy & installation of energy monitoring system at manufacturing locations: Hindustan Lever's experience

*Submitted by*
**Mr B B Dave**

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# CONTENTS

1. INTRODUCTION ..... 1

2. PROJECT SUMMARY ..... 2

  *2.1. SCOPE ..... 2*
  *2.2. OBJECTIVES ..... 2*
  *2.3. METHODOLOGY ..... 2*

3. THE COMPANY PROFILE ..... 5

4. REVIEW OF EXISTING POLICY ON ENERGY AND ENVIRONMENT ..... 6

  *4.1. CONCERN FOR SUSTAINABLE DEVELOPMENT ..... 6*
  *4.2. CONTEXT FOR REVIEW OF POLICY FOR IMPROVED ENERGY MANAGEMENT 7*
  *4.3. METHODOLOGY ADOPTED FOR REVIEW OF EXISTING POLICY ..... 8*
  *4.4. STEPS FOLLOWED FOR POLICY REVIEW ..... 10*
  *4.5. FINAL RECOMMENDATIONS ON ENERGY POLICY ..... 22*

5. DEVELOPMENT AND INSTALLATION OF ENERGY MONITORING AND REPORTING SYSTEMS ..... 22

  *5.1. MANAGEMENT COMMITMENT ..... 22*
  *5.2. CREATION OF ENERGY DATA BASE FOR 1996 ..... 23*
  *5.3. AWARENESS CAMPAIGNS ..... 25*
  *5.4. IDENTIFICATION AND CLASSIFICATION OF FOCUS AREAS THROUGH ENERGY MAPPING ..... 26*
  *5.5. ENERGY MONITORING AND REPORTING ..... 27*
  *5.6. USE OF ENERGY REPORT IN ENERGY REVIEWS ..... 29*
  *5.7. FORMATION OF TASK FORCES/TEAMS ..... 30*
  *5.8. ENERGY CONSERVATION (ENCON) PLANS ..... 30*
  *5.9. SETTING OF "MANAGEMENT BY OBJECTIVES" (MBOs) ..... 31*
  *5.10. ENERGY AUDITS ..... 31*
  *5.11. ORGANISING/CONDUCTING PLANT-SCALE TRIALS ..... 32*
  *5 12. ENERGY BENCHMARKING AND ZERO BASED STANDARDS ..... 32*
  *5.13. NETWORKING AND FEEDBACK ..... 33*

6. RESULTS OF ENERGY MANAGEMENT AND MONITORING IN 1997 ..... 34

  *6 1 COST SAVINGS BY ENERGY CONSERVATION ..... 34*
  *6.2. CALCULATION OF ENERGY SAVINGS ..... 34*
  *6.3. OVERALL SAVINGS FOR 19 UNITS MONITORED ..... 35*
  *6.4. CONTRIBUTION TOWARDS SUSTAINABLE DEVELOPMENT ..... 36*

7. CONCLUSION ..... 39

# Review of energy policy and installation of energy monitoring system at manufacturing locations: Hindustan Lever's experience

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## 1. INTRODUCTION

As a part of the PEERS -1997, each of the participants was to undertake a Project for implementation in his own organisation. By working on the design and implementation of the Project the participant was expected to have an insight to the issues involved and their solutions when planning a Sustainable Development programme.

This Project Report discusses energy issues such as energy policy and installation of energy monitoring system at the manufacturing units in Hindustan Lever Limited, a large scale consumer goods company in the private sector. The outline of the Project was briefly discussed at TERI, New Delhi during Phase I training in April - May, 1997.

The Project consisted of two parts. The first part deals with issues related to review of energy policy of the company with emphasis on Sustainable Development. The second part deals with the issues involved in the design and installation of a suitable energy monitoring and reporting system at the manufacturing locations of the Company. The report covers the achievements with quantitative results obtained through implementation, with the overall objective of moving towards sustainable development.

# 2. PROJECT SUMMARY

## 2.1. *SCOPE*

1. To review energy policy of the Company with specific objective of minimising emission of carbon dioxide and flue gases and thereby contribute towards Sustainable Development through energy conservation measures.

2. To conduct energy awareness campaigns and install energy monitoring and reporting system at manufacturing locations of the Company.

## 2.2. *OBJECTIVES*

1. To achieve significant reduction in the specific consumption of fossil fuels in Company's manufacturing operations.

2. To increase awareness about importance and relevance of energy conservation Company's manufacturing activities.

3. To install robust monitoring, reporting and evaluation systems to achieve and sustain continuous improvement in energy efficiency.

## 2.3. *METHODOLOGY*

The methodology adopted is briefly outlined below:

### A. ENERGY POLICY

- Improve energy awareness among stakeholders.
- Review current environment policy and integrate with it the energy issues, as necessary.

## INSTALL ENERGY MONITORING AND REPORTING SYSTEMS

- Obtain top management commitment
- Create energy database for 1996
- Conduct energy awareness campaigns for key personnel
- Identify/classify focus areas through energy mapping:
  - Process/Technology
  - Operating practices
  - Energy hygiene measures
  - Energy rationalisation
- Form task forces/teams
- Develop comprehensive factory-wise ENCON Plans:
  - Immediate term
  - Medium term
  - Long term
- Set specific MBO targets for 1997 for all key personnel:
  - Specific costs and specific usage
- Develop investment plans and estimate benefits
  - Raise capital proposals
  - Sanctions/approvals
- Formalise energy monitoring/reporting system at each location
- Conduct energy audits at priority locations
- Networking
- Plan for specific trials
- Develop product-wise zero-based standards
- Periodic Energy Reviews in factories and at Corporate level
- Energy benchmarking for continuous improvement
- Feedback for corrective action

## *2.4 RESULTS*

The report covers the results of monitoring energy in one of the "Profit Centres" of the Company and specifically the overall details for 19 manufacturing sites.

*THE COMPANY CONTRIBUTED TOWARDS SUSTAINABLE DEVELOPMENT BY SAVING OF FOSSIL FUELS OF 18,500 ToE OF FURNACE OIL WITH PROPORTIONATE REDUCTION IN THE EMISSION OF CARBON DIOXIDE AND SOX. IN ADDITION, THE FOCUSED APPROACH TO ENERGY MANAGEMENT HELPED THE COMPANY TO ACHIEVE AN OVERALL ENERGY SAVINGS OF RS 12 CRORES ON A BASE OF RS 76 CRORES IN THE FIRST YEAR OF MONITORING (1997) IN THE SOAPS/DETERGENTS PROFIT CENTRE.*

*ENCOURAGED BY THE RESULTS THE COMPANY HAS NOW PLANNED TO EXTEND THE SCOPE TO OTHER MAJOR PROFIT CENTRES AS WELL IN A PHASED MANNER.*

## 3. THE COMPANY PROFILE

Hindustan Lever Limited is an FMCG, professionally managed Indian company and is a subsidiary of the global consumer giant, Unilever, plc. Its business portfolio includes branded consumer products such as soaps, detergents, hot beverages(tea/coffee), personal products, culinary products, industrial chemicals, fertilisers, etc. The Company is in existence for over 70 years and is a dominant player in the Indian market with its overall market leadership in laundry and personal wash products. The annual turnover (1997) exceeded Rs 7,800 crores and it has a market capitalisation of over Rs 30,000 crores.

The Company has its manufacturing operations at more than 70 locations spread across the country. It employs about 24,000 persons directly and a similar number indirectly. It has one of the widest sales and distribution networks in the country. The company has favourable capital structure and strong liquidity position. The key strengths of the company lie in its marketing, distribution and financial functions, and the technology base that is continuously upgraded through innovations by a team of professional managers, to stay ahead of competition.

The Company strongly believes in and practises ethical corporate governance as a Responsible Corporate Citizen. This is amply covered in a widely circulated statement entitled "Corporate Purpose" (Annexure 1). The organisation structure of the company rests on a "Profit Centre" concept for each product category with its own director, who works almost autonomously under the overall direction by the Management Committee headed by the Chairman. The Chairman and full-time directors are usually the employees who come from the ranks from amongst the pool of professional managers of the company.

# 4. REVIEW OF EXISTING POLICY ON ENERGY AND ENVIRONMENT

The Company already has a well-articulated "Environment Policy" (Annexure 2) which is updated from time to time to enhance the focus on issues that directly concern its activities and has a bearing on the society. This Policy rests on the following premise as stated in the Foreword:

> *"The Company recognises its joint responsibility with Governments (Central & State) and the Public for the quality of the environment and is committed to regulate all its activities so as to follow best practicable means of minimising adverse environmental impact arising out of its operations"*

The scope of the Policy covers all stages of development of processes and products in all its manufacturing units. It also applies to new as well as existing processes and products. The Environment Policy prescribes the policy statement, its objectives and methodology of implementation. It is widely circulated to all its employees and other stakeholders who are directly interested in the Company's activities.

## *4.1. CONCERN FOR SUSTAINABLE DEVELOPMENT*

The company recognised, many years ago, the need for initiating evaluation of its business activities to move towards Sustainable Development. The company and its principals, Unilever in their worldwide network, have professed that the businesses across the world should share the view that there is a need for common goal in the area of Sustainable Development and not a conflict with the development of economy that is in harmony with the environment and Society, both for now and for future generations.

The company further believes that one of the greatest challenges for the businesses across the world in the next millennium, is to make the market forces work in a way that promotes protection and improvement of the environment - with the help of performance based standards and judicious use of economical instruments - in a harmonious regulatory framework. The Company in several international fora has advocated that the Corporate Policy and Implementation Strategy for any organisation, that is based on principles of Sustainable Development ,should include the following:

- *Accept corporate responsibility towards environment and the communities in which the organisation operates*
- *Scientifically assess impact of its business on environment*
- *Improve eco-efficiency i.e. manufacture safe products by use of clean processes as efficiently as possible*
- *Increase awareness amongst all stakeholders about sustainable development programs and achievements.*

The Company also believes that the business enterprise has to be selective in its approach to Sustainable Development such that it is in consonance with its business objectives. Some of the sustainability ideas such as tapping renewable sources for industrial oils while benefiting the poorer sections of society and harnessing of agricultural waste for packaging have already been successfully implemented by the company.

## *4.2. CONTEXT FOR REVIEW OF POLICY FOR IMPROVED ENERGY MANAGEMENT*

The manufacture of fast moving consumer products is not energy-intensive compared to other major chemical industries such as steel, oil, cement, paper, etc. The company's energy spend was just about 1.6% of sales volume(1996). Notwithstanding this, the company directors still felt the need to provide a focus on the energy management at its manufacturing sites, mainly due to the following considerations:

a) Though the specific consumption of energy was much lower than the industry average due to the very nature of products being manufactured, it was noticed that the energy costs formed a sizable part of the overall conversion costs. The energy costs were rising in 1996 and earlier at an inflation rate of about 15-25% that was substantially higher than the national average inflation of around 8-9%.

b) The competitive pressures on the business required a "De Novo" look at all elements of cost inputs including energy, formulate/ review policies and implementation strategies to achieve substantial savings to keep up the competitive edge in the market place.

c) To stimulate new ways of thinking and effect the change of "mind-set," improve consciousness, and thereby harness the long-term benefits from "Practical Creativity" as applied to all aspects of its business and to its employees at all levels.

d) The company felt that, however small it may be, it can make its humble contribution towards Sustainable Development in line with its Corporate Purpose and Policies, by conserving the use of precious fossil fuels in its manufacturing operations.

*With these objectives in view the Board decided to constitute a function called "Corporate Energy" to evaluate all aspects of energy management in the factories, advise on modifying, as necessary, the existing "Environment Policy" to focus on energy and institute robust energy monitoring system in the factories in a phased manner.*

### *4.3. METHODOLOGY ADOPTED FOR REVIEW OF EXISTING POLICY*

The Company basically followed a "top-down " approach for review of its existing Policy. After constituting the "Corporate Energy" function the Board decided on broad guidelines based on which a detailed work plan was to be designed by a "Committee" (as defined below) for review of existing Environment Policy and to integrate, as necessary, the energy related issues.

This was the time around which M/s Tata Energy Research Institute (TERI), New Delhi selected one manager of the Company for participation in PEERS-97. The exposure in Phase I at New Delhi in April-may, 1997 gave a holistic insight to the issues involved with Sustainable Development. On conclusion of Phase I a presentation was made to the top management by the Company representative on the learning from PEERS-97. Most of the company managers, at that time opined that PEERS -97 was addressing all issues in a holistic and general manner and not specifically energy alone. It was also recognised that PEERS - 97 was in progress with Phase II and III of the programme still to be completed. Hence the Company felt that it should, nevertheless, move forward with the task of reviewing its Policy without waiting for inputs from PEERS - 97.

### *4.4.1 IDENTIFICATION OF STAKEHOLDERS*

The Committee first made a list of possible stakeholders and then reviewed it with the top management and finalised it as given in Table - 1. The "stakes" of various stakeholders with respect to energy issues were also identified. The stakes of internal stakeholders were widely influenced by the policy review with positive as well as negative impact. In case of outside stakeholders, it was, however, recognised that since the issue being addressed was of "Energy Conservation" *within* the Company, it could possibly have only a positive influence, because these stakeholders ought to benefit from such a policy review through reduction in the use of fossil fuels.

Considering the discussions with various stakeholders within and outside the company the "impact" of policy review was assessed. The same is indicated in column 4 of Table - 1. Each of the internal stakeholders was then taken into confidence to the extent possible during the site awareness campaigns.

## TABLE - 1 : ENERGY POLICY REVIEW - STAKEHOLDERS

| | STAKEHOLDER | STAKES | WHETHER IMPACTING POLICY |
|---|---|---|---|
| A | **OUTSIDE COMPANY** | | |
| 1 | Central/State Govt. | -Encourage minimising impact on environment<br>-Revenue loss if fossil fuels are consumed less but Forex outgo expected to reduce | -Positive impact<br>-Neutral in view of supply less than demand and energy saving & forex outgo is a national priority |
| 2 | State Pollution Control Board | -Encourage reduction of fossil fuels to reduce GHG effect<br>-Minimise pollution from industries | -Positive impact<br>-Will lead to decreased pollution |
| 3 | Shareholders | -Improve profitability through reduced costs<br>-Continuous growth with more profits and dividends<br>- Good corporate governance | -Will be achieved through reduced costs<br>-same as above<br>-Will increase goodwill and trust |
| 4 | Consumers/customers | -Better quality and safe products/processes/ services<br>-Cheaper products and more value for less money<br>-Reliable products and services | -Positive impact<br>-Positive impact in the long run<br>-No impact |
| 5 | Suppliers | - More profitable business<br>- Sustained business | -Negative but rehabilitation possible |
| 6 | Trade | - More profitable business<br>-Value added products/ services | -Positive impact in the long run |
| 7 | Contractors/contract workmen | - More and sustained jobs<br>- Handsome remuneration | -Negative impact but insignificant |
| 8 | Public at large | - Better environment<br>-Pollution free living | - Positive impact in the lon run |
| 9 | Parent Company- Unilever | - Exceptional standards of corporate governance<br>-Fast growing profitable business | -Will be a move towards Sustainable Development<br>-Positive impact |

| B | **WITHIN COMPANY** | | |
|---|---|---|---|
| 1 | Management Committee(Board) | - Exceptional standards of corporate governance<br>-Fast growing profitable business<br>-Reduce costs to gain competitive advantage | -Will be a move towards Sustainable Development<br>-Positive impact<br>-Positive impact |
| 2 | Profit Centre Heads | -Same as above plus<br>-High priority | Same as above<br>-Priority according to size and quantum of energy usage |
| 3 | Factory Management (Team of managers/ officers) | -Reduce costs<br>-Minimum changes<br>- No/minimal investment<br>- Fast results<br>-Want shared responsibility | -Will be met<br>-Plans to be implemented with open mind<br>- To be a goal but not an end<br>-Would largely depend on their own plans<br>-Should "own" but can call upon expertise from within or outside the company |
| 4 | Support functions (Marketing/Technical) | - Value added products<br>- Lower response times<br>-Greater flexibility in manufacturing | -Will be met in the long run<br>-No impact<br>-May be affected but manageable |
| 5 | Corporate Safety Group | -Meet all safety norms<br>-Meet all environment norms | -Will reduce GHG emissions |
| 6 | Officers at factories | -Convenient operation<br>- Safe operation<br>-Greater participation in decision making | -Will impact and requires change of "mind-set"<br>-Plans to be cleared for safety before implementation<br>-Will encourage their participation |
| 7 | Workmen at factories | -Want "More for less"<br>-Convenient operation<br>-Safe operation<br>-Assured continuous employment | -No impact<br>-Will impact and requires change of "mind-set"<br>-Plans to be cleared for safety before implementation<br>-Some impact but manageable |

### *4.4.2 APPLICATION OF "BUSINESS CHARTER FOR SUSTAINABLE DEVELOPMENT" FOR REVIEW OF EXISTING ENVIRONMENT POLICY WITH RESPECT TO ENERGY ISSUES*

The Business Charter for Sustainable Development of ICC has a total of 16 principles(refer Annexure - 3).

Each of the principles were reviewed to first establish whether they were related to the issues being addressed, that is Energy. Then it was identified whether applicable principles are in line with Company's current policy and implementation strategy. If not, in which areas is it inadequate and how to go about upgrading it to meet the overall objectives.

The results of this extensive study are presented in Table - 2. This was arrived at by the Committee after thorough study of the Charter and subsequent consultation with members of the Management Committee.

TABLE - 2 APPLICATION OF ICC CHARTER TO THE POLICY

| Principle of ICC Charter | Whether applicable for Energy Issues | Whether covered by existing Policy |
|---|---|---|
| **Corporate Priority** - To recognize environmental management as among the highest corporate priorities and as a key determinant to sustainable development to establish policies, programs and practices for conducting operations in an environmentally sound manner. | Yes. The company promotes policies, programs and practices based on exhibiting responsible corporate behaviour | Yes. Adequately covered by "Corporate Purpose" and "Environmental Policy" documents. |
| **Integrated Management** - To integrate these policies, programs and practices fully into each business as an essential element of management in all its functions. | Yes. The current policies, programs and practices are applicable to all management functions. | To cover the specific energy issues review of the existing environmental policy is necessary. |
| **Process of Improvement** - To continue to improve corporate policies, programs and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations with legal regulations as a starting point; and to apply the same environmental criteria internationally. | Yes. Both the parent company and the Indian subsidiary promote a common Corporate Purpose that emphasise on continuous improvement of environmental performance utilising the expertise available in-house as well as outside. | Yes. Covered by the existing policy in the statement, aim and objectives. However, every issues need to be reviewed to address "energy" specifically. |
| **Employee Education** - To educate, train and motivate employees to conduct their activities in an environmentally responsible manner. | Yes. Training needs have been addressed and fulfilled through well defined policies and practices. | Yes. Adequately covered. |
| **Prior Assessment** - To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site. | Yes. Being practiced as per the statutory norms. | Covered by statement of objectives of complying with statutory norms. |
| **Products and services** - To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely. | Yes. the company intends to extend the scope of policy to include energy efficiency to minimise the impact of carbon dioxide emissions. | Yes. |

| S No | Principle of ICC Charter | Whether applicable for Energy Issues | Whether covered by existing Policy |
|---|---|---|---|
| 7 | **Customer Service**-To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services. | Not applicable | Yes. |
| 8 | **Facilities and Operations** - To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimisation of adverse environmental impact & waste generation, and the safe and responsible disposal of residual wastes. | Yes. The company wishes to promote energy efficiency. | Yes. |
| 9 | **Research** - To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimizing such adverse impacts. | Yes. | Yes. |
| 10 | **Precautionary Approach** - To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation. | Company's attempt is to contribute by minimising GHG emission by reduction of use of fossil fuels. | Not applicable except upgradation of activities that promote conservation of energy. |
| 11 | **Contractors and Suppliers** - To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers. | Yes. But limited application relating to energy issues. | Not covered but not mandatory for the purpose of current "Brief". |

| Principle of ICC Charter | Whether applicable for Energy Issues | Whether covered by existing Policy |
|---|---|---|
| **Emergency Preparedness** - To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, recognizing potential transboundary impacts. | Not applicable except to aspect of handling fossil fuels/power. | Yes. |
| **Transfer of Technology** - To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors. | This may be taken up only after assessing benefits of implementation of programmes and policies in the company. | Though not specifically covered by policy, this can be achieved after assessing benefits of implementation of programs and policies. |
| **Contributing to the Common Effort** - To contribute to the development of public policy and to business, governmental and intergovernmental programs and educational initiatives that will enhance environmental awareness and protection. | This may be taken up only after assessing of implementation of programs and policies in the company. | Not covered. |
| **Openness to Concerns** - To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance. | Yes. Openness and dialogue with employees is integral part of the company's policies. | Yes, covered adequately. |
| **Compliance and Reporting** - To measure environmental performance; to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public. | Yes. The energy monitoring system to be designed and implemented. | Yes. Adequately covered in the policy. However, energy monitoring/ reporting system to be designed and implemented as part of the existing policies. |

### *4.4.3 REVIEW OF "CORPORATE PURPOSE" DOCUMENT*

The Company has stated its Corporate Purpose as shown in Annexure 1. The theme of this statement is *common* for both the parent multinational, Unilever and the Indian company, Hindustan Lever Limited, since the nature of their business activities and principles governing corporate behaviour are essentially the same. With overall management control by the parent, Unilever, all broad policies are by and large based on common principles of governance.

Para 1 which deals with consumers, articulates an endeavour to improve "quality of life" through its products and services. Para 2 deals with focus on benefiting the local consumers through knowledge of local cultures/markets and international expertise. Para 4 expresses a belief of the company about the need of exhibiting the highest standards of corporate behaviour towards, among others, the societies and the world as a whole.

The message emanating from the above is that as far as energy issues are concerned, the company is going to view them on the basis of attaining the standards of corporate behaviour which it expects in all its business activities as these issues have direct and indirect bearing on the society in which the company operates.

*The Committee therefore recommended that the "Corporate Purpose" as stated is adequate for the purpose of covering the energy issues at the manufacturing level since it is in line with the stated intent of corporate behaviour across all functions and activities.*

### *4.4.4 CURRENT ENVIRONMENT POLICY*

The current policy document has 4 sections, namely,

- Policy statement
- Scope and aim of policy
- Objectives, and
- Methodology of Implementation and responsibilities

Each of the above were studied in details and views taken from all stakeholders. The outcome is summarised in the forthcoming paragraphs.

*POLICY STATEMENT:*

The statement is as follows (refer Annexure 2):

*"Use standards of environmental safety which are scientifically sustainable and commonly acceptable.*

*Review and continuously improve processes, the performance of products, services and operations as measured by their environmental impact.*

*Work in co-operation with members of industry, government agencies, relevant environmental bodies, suppliers and customers to promote the achievement of high standards of environmental care.*

*Promote responsibly the real advantages it has achieved whilst avoiding making false or misleading claims of environmental benefit."*

Para 2 deals with continuous improvement of processes as measured by their environmental impact. Further, Para 3 deals with cooperation with outside stakeholders to promote achievement of high standards of environmental care.

While originally the intent of the above was directly related to performance and its impact on environment ,the Committee was of the view that it covers the context of the company's intent of addressing energy issues. Since energy related issues are only a part of overall operational activities it was the considered opinion as expressed by most of the internal stakeholders that the Policy Statement adequately covers energy issues as it is an integral part of improving and achieving high standards resulting in minimisation of impact on the environment. *In other words the consensus emerged that the current policy statement allows the Company to focus on energy issues and in fact it encourages it to do so.*

◆

*SCOPE AND AIM:*

These are stated as follows:

*"Scope*

*The policy applies to each stage of development of a process and product, from research through full scale operation, in all operating units. It applies to every stage in the life cycle of a product i.e. a cradle to grave assessment. It applies to new as well as existing processes and products."*

*"Aim*

*The aim of the policy is to do all that is reasonably practicable to prevent or minimise and encompassing all available knowledge and information, the risk of an adverse environmental impact, arising from processing of the product, its use or foreseeable misuse. "*

The Scope as stated above adequately covers application of policy to each stage of development of a process and also full scale operation. In other words it is applicable to the manufacturing activities , existing or new, in its totality. If energy issues are covered in the objectives then it will automatically apply to the manufacturing units by this definition.

The Aim as defined signifies the extent to which an activity will be pursued. The Company's move to focus on energy itself is expected to result in minimising the adverse impact on the environment as the emission of GHG's is likely to reduce from the current levels. The words " reasonably practicable" are used to clarify that the intention is to do all that is practicable ( on a large scale and backed by adequate research/knowledge) and which is reasonable from techno-commercial point of view. This was well in line with the company's approach towards Sustainable Development as stated in Section on "Concern for Sustainable Development" of this Section. The "Aim" as stated is also sufficient and is applicable to the energy issues.

*OBJECTIVES OF THE POLICY:*

The objectives have been covered in detail in Annexure 2. The main focus is to conduct operations and manufacture products with minimum impact on the environment. It was felt that specific objectives relating to energy *are* covered and will suffice for pursuing effective energy management by virtue of the following objective statements in the policy:

To appoint and empower a member of staff to oversee all environmental matters and to manage relevant communication both internally and externally. For energy issues, this task is expected to be accomplished by a central facilitator, the Corporate Energy Manager.

To conduct factory operations in a manner which demonstrate awareness of the nature and extent of the impact on the environment.

To recycle waste or recover economically useful materials from waste as far as is reasonably practicable.

**To maximise the energy efficiency of processes thereby minimising emissions of carbon dioxide and other flue gases.**

CO2 is specifically mentioned and since the company energy policy relates to optimal use of fossil fuels it will amply cover the operation in various manufacturing units.

*RESPONSIBILITY FOR IMPLEMENTATION:*

The overall responsibility for implementation of the Policy rests with the head of the operating unit. This would also suffice for energy issues because the overall responsibility of energy management and implementation of energy programmes will also rest with him. The current Policy further allows him to call upon the expertise available from suitable specialists within or outside the company as stated in the Policy.

### *4.5. FINAL RECOMMENDATIONS ON ENERGY POLICY*

**Overall, it was felt that the current Environment Policy is adequate in its intent, scope, objective and assigning responsibility - among other issues - to the issues concerning energy management in manufacturing locations of the Company. After detailed debate the Board felt that the current Policy though, so far, not uniformly applied towards energy management, is adequate as it allows development of energy conservation plans and their implementation and thereby enable fulfilling the objective of minimising impact on environment by reduction of CO2 and other flue gases through conservation of fossil fuel in the factories.**

In order to drive an "Energy Movement" across the company's manufacturing units, it was considered prudent to first start focusing on the largest Profit Centre, i. e. Soaps and Detergents. It was decided to design and apply energy monitoring and reporting methodologies to all the 19 units of this Profit Centre. After reviewing the progress made during the first three quarters of 1997 it was to be extended to other priority profit centres/units. This approach was accepted by the Board.

## 5. DEVELOPMENT AND INSTALLATION OF ENERGY MONITORING AND REPORTING SYSTEMS

Having reviewed the energy policy, the next logical step was to workout a detailed implementation strategy. The first step in this direction was to design and install a suitable energy monitoring system.

In line with its objectives of achieving substantial cost reduction and move towards sustainable development through focused approach to energy management, the Board decided to take up Soaps and Detergents Profit Centre as the starting point. The Board directed the Corporate Energy Manager to concentrate on achieving energy saving in 1997 in all the 19 manufacturing locations of this profit centre.

### *5.1. MANAGEMENT COMMITMENT*

It was clear from the beginning that while the policy itself was adequate to promote improved energy management, its implementation would not be feasible and acceptable to all unless it is backed by unwavering commitment from top. This commitment was required for initiation as well as review of the energy management systems during the course of the year.

Since the Board was already committed to the energy issues it was relatively simple to obtain the required commitment from the Divisional Vice-President (DVP), in charge of the manufacturing sites and General Manager-Technical, in charge of the development department.

### *5.2. CREATION OF ENERGY DATA BASE FOR 1996*

The top commitment was first demonstrated by an address to a group of Factory Managers from Units by the DVP, wherein their co-operation was sought to spearhead energy conservation programme. They were requested to furnish the details relating to energy use in 1996 in their respective units to the Corporate Energy Manager.

Before embarking on preparing a list of data required for creating the energy data base, a visit was made to one of the major factories to understand the processes involved in soaps and detergents manufacturing. Further, from the "Factory Passports"(they contain basic data on products and processes), and through discussions with General Manager-Technical, an overview of each unit, product categories, historical background and details of processing systems were collected. It was clear that there existed an abundant similarity in the processes in these factories although there was wide variations in each process module and in the type of hardware installed at the Units.

It was identified that the following information is required from each unit to have a meaningful energy data base which would indicate the current status in each factory:

Nominal production of each product group/category

Total consumption of each type of energy - grid power, captive power (DG power), coal, furnace oil, HSD, RFO, LDO and any other fuel used.

Total steam generation and consumption

Specific consumption of power, steam and fuels used directly in the process.

Specific energy costs for each product/category as well as overall specific energy cost incurred by the unit.

Total cost incurred by the unit towards the purchase of all energy inputs.

Quantity of power and fuels used in giga joules(GJ).

- Average delivered price of each utility during the year
- Identification of any major factory which might have influenced the energy usage during the year (exceptional items)

Although the use of water as a utility could have been considered as a part of total energy, the same was excluded from the purview of the 1996 data base to avoid confusion between water used as utility and that used for process systems.

The data thus collected was classified for each unit under the following heads:

- Nominal production in tonnes
- Total energy bill for power and fuels in Rs. lakhs
- Specific energy costs in Rs./tonne
- Specific power consumption (Grid and DG) in Kwh/tonne
- Specific fuel consumption (all fuels put together with calorific value parity) in expressed as multiples of 1000 Kcal/tonne

A typical collection of such data from *a unit*, as an example, is given in Table - 3A and the overall database *for 19 units* is indicated in Table - 3B.

The overall 1996 energy scenario for soaps and detergents profit centre was as summarised below:

- The total energy bill was Rs 67 Crores
- Specific energy cost on total volume basis was Rs 1065 / tonne at current cost of money
- Specific power and fuel consumption on total volume basis was 131 Kwh / tonne and 1,358,000 Kcal / tonne.

The above data formed the basis for developing energy management plans, monitoring energy performance and estimation of savings. The target for 1997 for each unit was to achieve substantial reduction in the above parameters during 1997.

## *5.3. AWARENESS CAMPAIGNS*

The next step was to conduct energy awareness campaigns at factories and other fora such as factory manager's workshops and during training sessions at the training centres where officers and managers from the manufacturing units participated. The awareness campaign concentrated on "why, what and how "of energy management with special emphasis on the following:

Country's energy scenario and the importance of energy as the national priority

Company's energy scenario followed by specific energy scenario for the profit centre

Company's policy and responsibilities of the factories as related to energy issues

Development of Energy Conservation(ENCON) Plans and methodology of implementation

Standardised format for monitoring energy parameters on a monthly basis at the Unit level and for MIS reporting to Head Office.

The awareness campaigns, which involved all officers and managers, technical and non-technical, also covered briefly the tips for energy savings at home. The campaign module further included capsules for "energy mapping" in the factories as well as "leak monitoring systems."

During these campaigns it was found that many Units did not have sufficient metering devices for monitoring energy in each process/plant in the factory. Obviously these factories could not give specific consumption data for each product separately without having proper metering systems. They could however give data on total purchased energy inputs and total production.

**These energy campaigns clearly established that focus on energy management involved the process of changing the "mind-sets" of factory personnel at all levels. The campaigns gave an opportunity to the employees to stimulate their thinking to look at the current energy usage and related practices in a different way, which could form the basis for generating energy saving ideas.**

A number of impediments were experienced during the campaigning as well as during the year. A conscious effort was made to clear the doubts and thereby try to remove the impediments at the earliest possible. Some of the impediments which are by and large common with any issue of "change management" are as follows:

POSSIBLE IMPEDIMENTS

- Nothing new
- One more format
- Only small cost
- Already done enough
- Already better than others
- Can't do it alone
- I do but others don't
- Who gets credit
- Well established, well proven
- No money/no sanction
- No company focus
- Resource constraints
- No metering
- Flexibility constraints
- Distant results
- Will affect productivity
- May create IR situation

## *5.4. IDENTIFICATION AND CLASSIFICATION OF FOCUS AREAS THROUGH ENERGY MAPPING*

While most factories had the original utility distribution flow diagrams, some factories did not have. However, it was noticed that most of the available drawings were outdated since significant modification/upgradation were carried out at the manufacturing units over a period of time. Therefore, each unit was encouraged to develop an energy map for each utility including generation, distribution and consumption centres for each plant/activity in the Unit.

These energy maps were then studied in detail identifying "productive" and "non-productive" uses of energy. The productive energy was the one which was directly related to production whereas non-productive energy was related to operation of support activities such as administration and common utilities (i.e. water system, ETP, street lighting, etc.) which could not be related to production directly.

The energy mapping in this fashion helped in identification of focus areas in each department/plant/section of the factory. The **focus areas** then were classified into the following main categories:

**Process/technology related** - The areas where the usage of energy was related to the process or technology in operation

**Operating practices** - This included start/stop of utilities, underloading of plants, deviation from design conditions, operational convenience, etc.

**Energy hygiene measures** - This included issues such as steam and air leaks, wastage of lighting and power, operation of underloaded equipment, heat losses from hot and cold surfaces, etc.

**Energy rationalisation** - This identified opportunities for rationalisation of certain operations/processes within the unit or of the whole unit.

The energy mapping helped in identifying two out of 19 units where energy consumption levels were abnormally high compared to other units. This was attributed to a variety of reasons such as IR situation, very low production volumes, poor infrastructure, etc. During the year such units were found to be inefficient even in terms of production volumes, productivity and asset utilisation. During the periodic reviews at the Board level it was concluded that instead of improving energy efficiency in these Units it would be prudent to plan phasing out their manufacturing activities and shift them to other relatively efficient locations.

## 5.5. *ENERGY MONITORING AND REPORTING*

The basic instrument for monitoring the use of energy inputs in any specific factory required that there was collation of data and interpretation which would indicate whether the use of energy was efficient or not, compared to base data for 1996. For monitoring and control of energy, it was therefore, necessary to have a standard monitoring-cum-eporting format.

The survey of 19 units indicated that a few factories did have a reporting system in practice for several years. However, it was recognised that since these reports did not focus on specific costs and usage it did not serve a very useful purpose for control of energy inputs.

It was, therefore, necessary to design a simple but effective reporting format which would include all the data required to determine the energy efficiency and costs.

After thorough study of the type of products/categories being manufactured in the profit centre, type & variety of power and fuel inputs and usage of energy in the form of power, steam and direct fired fuels, a new one-page format was designed and introduced for monitoring energy on a monthly basis for each unit. A typical monthly energy consumption report is indicated in Table - 4. The details contained in this report on monthly and cumulative basis are as follows:

### *5.5.1 CONTENTS OF MONTHLY ENERGY REPORT*

Reference is made to Table -5 for the Energy Report Format.

**General :** The top of the report format contains identification of the "Unit" and "Month".

**Section 1 :** This section gives data on **nominal production volumes for each product/category as well as total volume.** This section also gives total energy consumption in their respective units for power as well as various fuels. This is complemented by the average delivered price (or rate per unit) for each of the energy inputs. Further in this section the total quantity of export steam (steam ex-boiler) alongwith its rate is also indicated.

**Section 2:** This section by far is the most important section of the energy report. It indicates **specific consumption per tonne of each product for each fuel**. It is noteworthy that where direct measurement of energy for a specific product was not possible, an allocation method was used in which allocation was made in proportion to the "standard consumption" worked out as outlined in the subsequent section of this Chapter.

This section also included boiler efficiency expressed as Evaporation Ratio i. e. qty of steam produced per unit weight of fuel. In case of multi-fuel boilers this was done with CV parity.

**Section 3:** This section deals with **utility-wise total cost for the month for each product/category**. It also gives total **specific cost in Rs/T for the month as well as cumulative for the year.**

**Section 4:** This section gives **total purchase cost for all energy inputs** put together obviously it is adjusted for any fuel used for captive power generation so that double accounting is avoided.

**Section 5:** This section gives **energy inputs** by the Unit for the month and cumulative in terms of **giga joules** separately for power and other fuels. This value is calculated using the standard calorific value of individual energy input.

**Responsibility:** The key to filling up the data in the report was to clearly assign the responsibility for **preparation and checking of the report contents**. After initial trial a rule was made that the report will be prepared by the energy coordinator of the factory (Factory Manager or Factory Engineer or Production Manager as the case may be ) and will be subsequently checked by the accounts department of the Unit. This was done to reconcile the figures of energy report with those in the accounts books of the Unit.

The Units were required to fill up only the "shaded" area and the rest of the calculations were done through computer.

The above report format was introduced starting Jan 1997 for each Unit. The Unit was given a week's time after the closing of the book month to submit the report to the Factory Manager of the Unit as well as to Head Office. The initial response was sluggish as it took some time for people to understand and appreciate the relevance of the report but subsequently it became a standard practice to prepare, discuss and submit the report in time.

### *5.6. USE OF ENERGY REPORT IN ENERGY REVIEWS*

The above energy report was discussed every month within the Unit during "Technical Efficiency" meetings where the energy bill, specific energy costs and specific usage were discussed and compared with the data for 1996 as well as with the performance during the preceding months. If the performance was deteriorating then the factory team was to gear up to develop an action plan to improve the performance. **Review at the unit level was the focal point for achieving ambitious targets and continuously improve the energy efficiency.**

The energy report from various Units were also reviewed at Head Office with Divisional Vice-President(DVP) of the Profit Centre every month. This was a "macro level performance review" where performance of each Unit was discussed on a "total volume basis". In this review the progress towards overall energy savings and implementation of Energy Conservation(ENCON) plans were also discussed in detail.

The energy data collected through the monthly reports were also presented to the Management Committee every two months during the profit centre review. This forum included Chairman as well as some of the directors on the Board. Typical charts from the presentation made are shown in Figures - 1, 2 and 3.

Some of the investment plans were also presented during the course of this meeting to obtain monetary approvals from the authority.

Besides the reviews as stated above, an effective way of providing continued focus was to present the data in the Factory Manager's meeting held once every quarter. This gave an opportunity for various Unit Heads to interact with each other and share their views as well as the results achieved.

### *5.7. FORMATION OF TASK FORCES/TEAMS*

In each unit, one or more teams were formed which included managers and/or officers to look into the specific areas of energy savings. Each team was responsible to generate its own ENCON plan for implementation in the specific area chosen by them.

Some teams were also formed by selecting personnel from amongst many Units to focus on ideas of common interest. These teams functioned throughout the year by visiting each other's Unit as well as by constant communication through cc:Mail.

### *5.8. ENERGY CONSERVATION (ENCON) PLANS*

In order to implement ideas it was necessary to encourage the units to develop comprehensive energy conservation plan. Initial stimuli was given in the form of a preliminary document entitled "Strategy for Energy Management" as indicated in Annexure 4. The ideas were classified in three broad categories given below:

- **Immediate term :** Ideas which required no/minimal investment and can be implemented immediately.

- **Medium term:** Ideas which required investment but could give a payback of less than 12 months with good DCF yield.

- **Long term:** Ideas which required investment and had a payback of upto 24 months. with good DCF yield.

Some of the ideas generated and accepted for detailed study during the year are given in Annexure 5. Though these ideas are product or process specific they served well to amplify the scope that existed in all the units.

It is noteworthy that any idea which gave a payback of more than 24 months were *shelved for the time being* for possible implementation in future. This was done as the company recognised that the energy scenario as well as product portfolio were dynamic in nature encountering rapid changes. This was not conducive to implement any long term energy plans which would pay back in more than two years.

The plans which required investment had to be backed up by raising capital proposals by the unit for obtaining approval from the appropriate authority for the capital and/revenue investments.

The ENCON plan was a time-bound action plan with clear responsibilities assigned. A typical action plan for one of the detergents Unit is shown in Annexure 6.

## *5.9. SETTING OF "MANAGEMENT BY OBJECTIVES" (MBOs)*

The company has a well established performance appraisal and reward system for managers and officers. This system is based on the principles of "Management by Objectives" Each manager/officer has 5 key objectives which are agreed by him with his superior in the beginning of the year. The MBOs are ambitious and have an "element of stretch" but are achievable. They require planning, innovation, stewardship and above all a zeal to accomplish targets as individual as well as one of a team.

In order to involve the key personnel in the energy movement they were encouraged to take one of the MBOs based on energy efficiency. The energy MBO was generally in the form of quantification of savings to be achieved over 1996 in terms of specific costs and/or specific usage of energy input.

This was found to be a very effective tool to harness the "practical creativity" of individuals.

## *5.10. ENERGY AUDITS*

The company made use of the services of eminent external energy auditors at its major units. Some of the auditors who worked in the units are TERI, CII, Forbes Marshall, ECON consultants, etc.

It was, however, recognised that the external auditors could mainly concentrate on utilities systems as they were unfamiliar with the process systems. The latter were audited mainly by the unit teams themselves as they knew their systems best. The ideas generated through external and internal audits were rolled out to various units. In addition, a list of common measures in the utilities area was also prepared for company-wide circulation.

## *5.11. ORGANISING/CONDUCTING PLANT-SCALE TRIALS*

It was recognised that some of the ENCON ideas were based on technology initiatives taken by the units but required a plant-scale trial to establish its techno-economic feasibility. In order to expedite outcome from such trials, it was planned to carry out specific trials at specific locations and then roll out the results to other Units if the trials were successful and share the experience if the trials were not successful.

**A number of technical trials on the bsis of the ideas listed in Annexure 5 were conducted and rolled out throughout the year which was responsible for the handsome contributions realised by way of meeting sustainable development objectives and substantial energy savings.**

## *5.12. ENERGY BENCHMARKING AND ZERO BASED STANDARDS*

The benchmarking for energy was promoted with the **classical three stages** as follows:

- **Unit best:** Replicate the best monthly performance for a longer period.
- **Company best:** Surpass unit best and strive for company best performance - Identify factors influencing company best performance.
- **Develop** ideal operations and **zero-based standards:** For a given process hardware the zero-based standards under ideal operating conditions would mean the ultimate minimum energy usage.

The results of energy monitoring indicated that in case of some product categories, most of the Units were close to achieving the zero-based standards. Therefore, it was necessary to go beyond the classical three stages of benchmarking., The **fourth stage** was to look for **more energy-efficient technology either in-house or from outside.** A clear strategy was developed for such product categories to evaluate new energy-efficient technologies to replace/ modify the old ones.

### *5.13. NETWORKING AND FEEDBACK*

Throughout the year, it was the responsibility of the Corporate Energy Manager to provide feedback and motivate Unit teams to do “networking” amongst themselves in order to -

a. Provide easy accessibility to the available best practices

b. Provide scope for corrective action

c. Enthuse competition amongst Units

Networking, therefore, was one of the key features of the energy management programme which reduced the overall response time and avoided “re-inventing wheel”.

●

# 6. RESULTS OF ENERGY MANAGEMENT AND MONITORING IN 1997

The cost-benefit analysis were carried out for each of the action points of the ENCON Plan. The payback period and DCF yields were calculated in each case as per the standard company accounting practice. The monetary proposals were raised by each unit for the actions planned in the medium and long term as defined earlier.

## *6.1. COST SAVINGS BY ENERGY CONSERVATION*

In 1997 the savings resulted from measures which are broadly classified the categories shown in Figure 4. They are as follows:

a) Process/technology related e.g.:

b) Energy hygiene(minimise obvious wastage) e.g.:

c) Rationalisation of processes e.g.:

d) Modifying operating practices e.g.:

e) Energy input optimisation e.g.:

## *6.2. CALCULATION OF ENERGY SAVINGS*

The results of the implementation of the energy policy and energy management concepts as detailed above were collated for the 19 Units under review. For calculating the energy savings it was necessary to compare the energy usage data with that of 1996 both in terms of costs and specific consumption of *each energy input for each product at each unit.* It was also necessary to compare the costs (to determine savings) in constant terms, say at 1996 costs. The savings calculations had to be accounted for correctly for each Unit. This was accomplished by following the stepwise procedure outlined below *applicable to each product/category at each unit:*

A) Determine specific usage of each fuel type for 1996 from the database. This represented the usage as if the "business continued as usual."

B) Determine the current energy price for a given month in 1997 from the monthly energy report submitted by the unit.

C) Determine nominal volume produced during the month for a given product or a group of products from the monthly report submitted by the unit.

D) Determine the product A x B x C = Prorata energy cost for the Unit.

E) Subtract actual energy cost for the month from the prorata cost calculated in D above. This represents the savings made during the current month. If this figure was *negative* the actual cost was less than that otherwise incurred had there been no measures taken for energy conservation and thus indicated positive savings . If the difference of Item E above was *positive* there was cause for concern as the energy performance was worse than that in 1996.

The above method takes care of the following:

- It makes the figures inflation proof because current price of energy is considered.

- Is corrected for the current volume of production

*The Prorata energy cost thus determined is compared with the actual cost incurred for a given period. The energy saving is then the difference between the prorata cost(i.e. if the specific usage was the same as in 1996) and the actual energy cost, for the production volume of the current period.*

A typical example of calculating savings for one month is illustrated in Table 6A and 6B.

### *6.3. OVERALL SAVINGS FOR 19 UNITS MONITORED*

As stated earlier, through increased energy awareness at all levels, stupendous teamwork and unwavering top commitment alongwith experimentation with innovative energy initiatives in improving process/technology and practices, the company could achieve substantial reduction in the overall energy bill in the soaps/detergent Units. **On a prorata energy bill of Rs 76 Crores a saving of Rs 12 crores was registered in**

**1997.** The energy bill for the 19 Units being monitored during the year was Rs 64 Crores that, in constant terms, is a reduction of 16% over 1996.

The specific energy cost (on total production volume) was reduced from Rs 1065 per MT to Rs 897 per MT. The specific power consumption reduced from 131 Kwh/MT to 123 Kwh/MT, a reduction of 6%. Further the specific fuel input reduced from 1,358,000 Kcal/kg to 1,073,000 Kcal/MT which is **21% reduction over 1996**. The results of monthly monitoring of specific energy costs and specific usage are shown in Figures - 1, 2 and 3.

## *6.4. CONTRIBUTION TOWARDS SUSTAINABLE DEVELOPMENT*

*The above savings resulted in the significant reduction of the quantity of fossil fuels(coal, furnace oil, HSD, residual furnace oil and power) being used in the 19 units under monitoring. This quantity was estimated to be about 18,500 ToE furnace oil with corresponding reduction in CO2 and flue gas emissions. Thus the installation of energy monitoring system helped in accomplishing the objectives specifically stated in the Company's Policy (Annexure 2).*

It was recognised that apart from reduction in the use of fossil fuels there were other numerous benefits to the environment. Some of them were identified as follows:

- Reduction in the use of ground water for utilities
- Reduced transportation and congestion on roads serving the units
- Reduced NOX and SOX levels from boiler stacks
- Reduced solids waste generation(reduced fly ash)

Figure 1

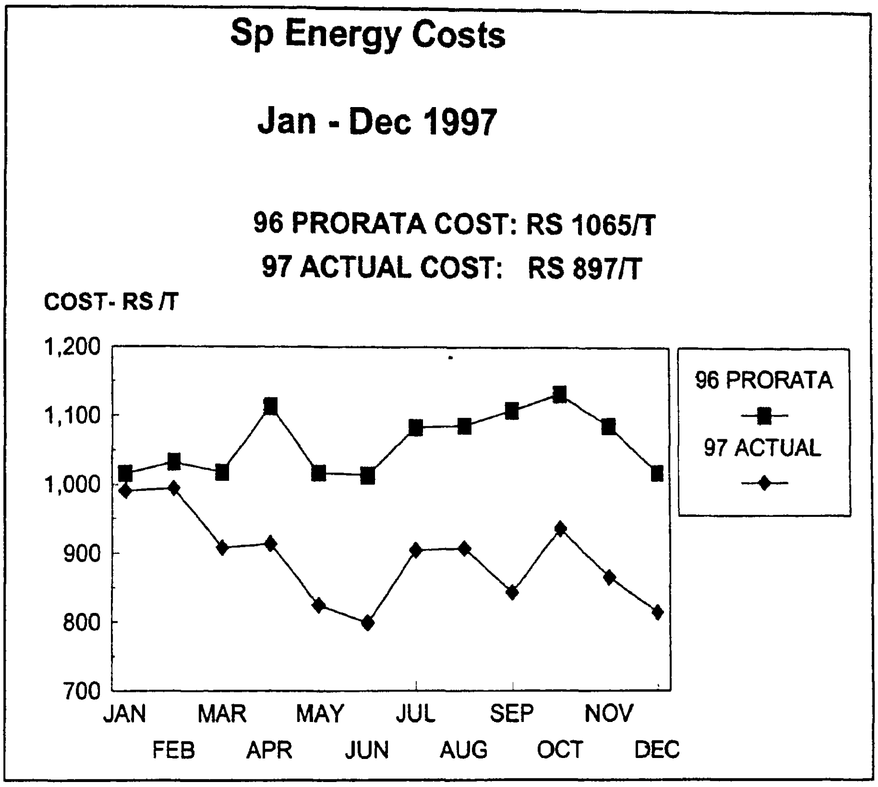


Figure 2

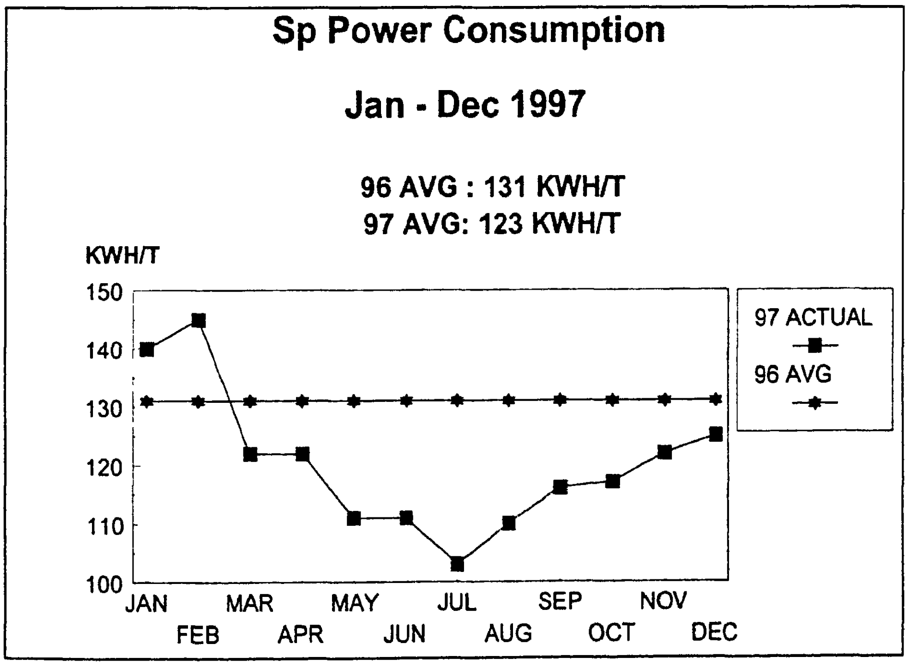
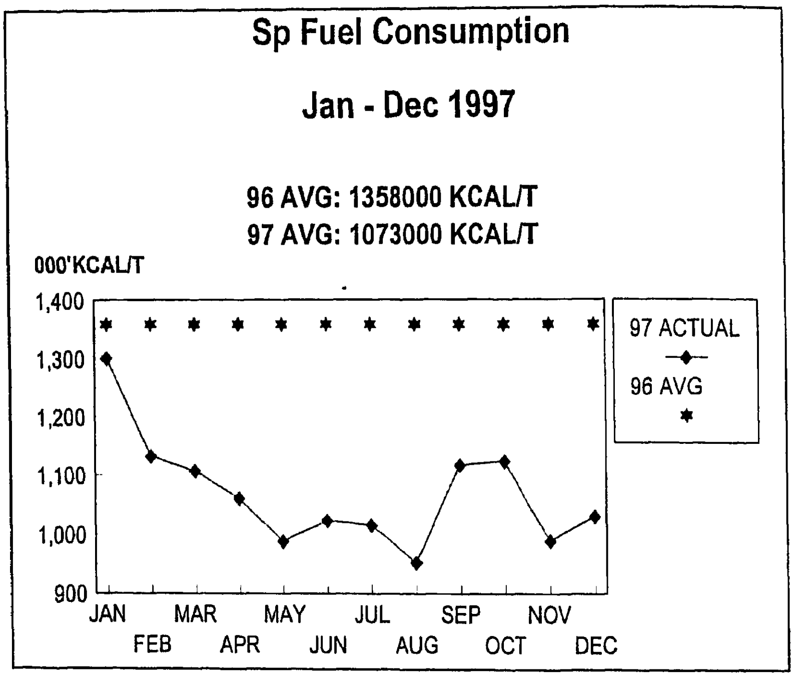


Figure 3


Sp Fuel Consumption
Jan - Dec 1997
96 AVG: 1358000 KCAL/T
97 AVG: 1073000 KCAL/T
000'KCAL/T
1,400
1,300
1,200
1,100
1,000
900
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
97 ACTUAL
96 AVG

## 7. CONCLUSION

Hindustan Lever Limited, a premier FMCG Indian company has a well defined and articulated environment policy. The company believes and promotes a move towards Sustainable Development, on the basis of its policy, corporate purpose and ethical corporate governance. The review of its current policy indicated that it adequately addresses energy related issues and thereby enables the company to focus on a programme of continuous improvement of the energy management in its manufacturing units. Although the business activities of the company are not highly energy intensive, the company still believes in upgrading energy management systems.

The company has demonstrated an emulative energy performance during the year 1997 when it decided to install a robust energy monitoring and reporting system in its largest profit centre - Soaps and Detergents - at 19 manufacturing units. Its basis of comparison has been with the performance during the previous year in terms of total energy costs, specific energy cost and specific usage of individual energy inputs.

Through increased energy awareness at all levels, stupendous teamwork and unwavering top commitment alongwith experimentation with innovative energy initiatives in improving process/technology and practices, the company could achieve substantial reduction in the overall energy bill in their soaps and detergents units. On a prorata energy bill of Rs 76 Crores a saving of Rs 12 Crores was registered in 1997. The energy bill for the 19 units being monitored for the year 1997 was Rs 64 Crores that, in constant, terms, is a **reduction of 16% over 1996**. The specific energy cost (on total production volume) was reduced from Rs 1065 per MT to Rs 897 per MT. The specific power consumption reduced from 131 Kwh/MT to 123 Kwh/MT, a reduction of 6%. Further the specific fuel input reduced from 1,358,000 Kcal/MT to 1,073,000 Kcal/MT that is **21% reduction over 1996.**

Encouraged by the benefits from the focused approach to energy management, the company has now decided to extend the principles to their other profit centres.

With the above, the company has taken one more step to move towards Sustainable Development. The reduction in usage of fossil fuels in 1997 to the extent of 18,500 ToE has resulted in corresponding reduction in emission carbon dioxide and flue gases in the company's manufacturing operations.

ANNEXURE 1

# CORPORATE PURPOSE

Our purpose in Unilever is to meet the everyday needs of people everywhere - to anticipate the aspirations of our consumers and customers and to respond creatively and competitively with branded products and services which raise the quality of life.

Our deep roots in local cultures and markets around the world are our unparalleled inheritance and the foundation for our future growth. We will bring our wealth of knowledge and international expertise to the service of local consumers - a truly multi-local multinational.

Our long term success requires a total commitment to exceptional standards of performance and productivity, to working together effectively and to a willingness to embrace new ideas and learn continuously.

We believe that to succeed requires the highest standards of corporate behaviour towards our employees, consumers and the societies and world in which we live.

This is Unilever's road to sustainable, profitable growth for our business and long term value creation for our shareholders and employees.

Unilever

ANNEXURE-2

# Environment Policy

HINDUSTAN LEVER LIMITED

**Hindustan lever limited (HLL) manufactures and markets high quality and safe products which meet the daily needs of consumers and industries.**

**The Company recognises its joint responsibility with Governments (Central & State) and the Public for the quality of the environment and is committed to regulate all its activities so as to follow best practicable means of minimising adverse environmental impact arising out of its operations.**

**HLL is committed to making its products environmentally acceptable, on a scientifically established basis, while fulfilling consumers' requirements for excellent quality, performance and safety.**

# POLICY STATEMENT

**Hindustan Lever Limited's policy is to :**

Use standards of environmental safety which are scientifically sustainable and commonly acceptable.

Review and continuously improve processes, the performance of products, services and operations as measured by their environmental impact.

Work in co-operation with members of industry, government agencies, relevant environmental bodies, suppliers and customers to promote the achievement of high standards of environmental care.

Promote responsibly the real advantages it has achieved whilst avoiding making false or misleading claims of environmental benefit.

# SCOPE AND AIM OF POLICY

## Scope

The policy applies to each stage of development of a process and product, from research through to full scale operation, in all operating units. It applies to every stage in the life cycle of a product, i.e a cradle to grave assessment. It applies to new as well as existing processes and products.

## Aim

The aim of the policy is to do all that is reasonably practicable to prevent or minimise and encompassing all available knowledge and information, the risk of an adverse environmental impact, arising from processing of the product, its use or foreseeable misuse

# OBJECTIVES

**To implement this policy, the Company objectives are:**

- To appoint and empower a member of staff to oversee all environmental matters and to manage relevant communication - both internally and externally.
- To comply with all local and national environmental laws and regulations.
- To comply with all government guidelines and codes of practice.
- To operate to the best practices of industry in accordance with guidelines produced by Unilever or an appropriate industry association.
- To co-operate and interact with national and local authorities concerned with protection of the environment,
- To participate, wherever possible, with consultative bodies advising on environmental legislation and thereby substantially contribute to enhance local knowledge and experience vis-a-vis international attitudes
- To conduct factory operations in a manner which demonstrate awareness of the nature and extent of the impact on the environment.
- To maintain effective procedures, consistent with available technology, to prevent environmental incidents

- To store and use chemicals or other materials in a safe manner and in such a way as to minimise risks of pollution incidents.
- To maintain procedures to enable a quick response to be made to any incident which may occur, thereby minimising environmental damage or nuisance.
- To minimise usage of raw materials through optimisation of process controls
- To maximise the energy efficiency of prossesses thereby minimising emissions of carbon dioxide and other flue gases
- To assess fully the environmental impact of new products, plants and processes at the design stage.
- To obtain from all suppliers of raw materials the precise chemical composition of the materials supplied, particularly those which even in trace quantities may be harmful to the environment.
- To recycle waste or recover economically useful materials from waste as far as is reasonably practicable.
- To provide appropriate training for employees, emphasising individual responsibilities for sound environmental management.
- To carry out internal audits to demonstrate compliance with policy and with local or national regulations.
- To maintain procedures for the investigations of all environmental incidents or complaints and to take such action as is reasonably practicable to prevent recurrence.
- To practise good house keeping which is fundamental for sound environmental management system

## IMPLEMENTATION OF POLICY

The policy will be implemented at the operating unit level.

**The overall responsibility for implementation and maintaining standards of the Environmental Policy rests with the Head of the operating unit. He will :**

- Take steps in protecting the environment through continuous improvements in the environmental impact of operation.
- Meet or exceed the requirements of legislations and responsible consumer opinion.
- Increase environmental awareness by appropriate training of employees.
- Ensure that in the implementation of this policy, the unit is able to call upon the expertise available from suitable specialists within or outside the company.

All Managers have specific responsibility for the implementation of the policy in areas under their control They are required to ensure that all activities are conducted in a responsible manner which is compatible with the Objectives of the Company's Environmental Policy.

- All employees have a duty to observe rules and practices which apply to the job or work area in which they are employed and to report any faults or malpractices to their immediate supervisor. They should be aware of any actions which may have an effect on environmental issues and at all times must co-operate with the Company to ensure that legal requirements, the Environmental Policy and internal procedures are satisfied.

ANNEXURE-3

## Foreword

There is widespread recognition today that environmental protection must be among the highest priorities of every business.

In its milestone 1987 report, "Our Common Future", the World Commission on Environment and Development (Brundtland Commission), emphasized the importance of environmental protection in the pursuit of sustainable development.

To help business around the world improve its environmental performance, the International Chamber of Commerce established a task force of business representatives to create this Business Charter for Sustainable Development. It comprises sixteen principles for environmental management which, for business, is a vitally important aspect of sustainable development.

This Charter will assist enterprises in fulfilling their commitment to environmental stewardship in a comprehensive fashion. It was formally launched in April 1991 at the Second World Industry Conference on Environmental Management.

## Introduction

Sustainable development involves meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Economic growth provides the conditions in which protection of the environment can best be achieved, and environmental protection, in balance with other human goals, is necessary to achieve growth that is sustainable.

In turn, versatile, dynamic, responsive and profitable businesses are required as the driving force for sustainable economic development and for providing managerial, technical and financial resources to contribute to the resolution of environmental challenges. Market economies, characterised by entrepreneurial initiatives, are essential to achieving this.

Business thus shares the view that there should be a common goal, not a conflict, between economic development and environmental protection, both now and for future generations.

Making market forces work in this way to protect and improve the quality of the environment - with the help of performance-based standards and judicious use of economic instruments in a harmonious regulatory framework - is one of the greatest challenges that the world faces in the next decade.

The 1987 report of the World Commission on Environment and Development, "Our Common Future", expresses the same challenge and calls on the cooperation of business in tackling it. To this end, business leaders have launched actions in their individual enterprises as well as through sectoral and cross-sectoral associations.

In order that more businesses join this effort and that their environmental performance continues to improve, the International Chamber of Commerce hereby calls upon enterprises and their associations to use the following Principles as a basis for pursuing such improvement and to express publicly their support for them.

*Note: The term environment as used in this document also refers to environmentally related aspects of health, safety and product stewardship.*

Individual programmes developed to implement these Principles will reflect the wide diversity among enterprises in size and function.

The objective is that the widest range of enterprises commit themselves to improving their environmental performance in accordance with these Principles, to having in place management practices to effect such improvement, to measuring their progress, and to reporting this progress as appropriate internally and externally.

## Principles

**1. Corporate priority**
To recognise environmental management as among the highest corporate priorities and as a key determinant to sustainable development; to establish policies, programmes and practices for conducting operations in an environmentally sound manner.

**2. Integrated management**
To integrate these policies, programmes and practices fully into each business as an essential element of management in all its functions.

**3. Process of improvement**
To continue to improve corporate policies, programmes and environmental performance, taking into account technical developments, scientific understanding, consumer needs and community expectations, with legal regulations as a starting point; and to apply the same environmental criteria internationally.

**4. Employee education**
To educate, train and motivate employees to conduct their activities in an environmentally responsible manner.

**5. Prior assessment**
To assess environmental impacts before starting a new activity or project and before decommissioning a facility or leaving a site.

**6. Products and services**
To develop and provide products or services that have no undue environmental impact and are safe in their intended use, that are efficient in their consumption of energy and natural resources, and that can be recycled, reused, or disposed of safely.

**7. Customer advice**
To advise, and where relevant educate, customers, distributors and the public in the safe use, transportation, storage and disposal of products provided; and to apply similar considerations to the provision of services.

**8. Facilities and operations**
To develop, design and operate facilities and conduct activities taking into consideration the efficient use of energy and materials, the sustainable use of renewable resources, the minimisation of adverse environmental impact and waste generation, and the safe and responsible disposal of residual wastes.

**9. Research**
To conduct or support research on the environmental impacts of raw materials, products, processes, emissions and wastes associated with the enterprise and on the means of minimising such adverse impacts.

**10. Precautionary approach**
To modify the manufacture, marketing or use of products or services or the conduct of activities, consistent with scientific and technical understanding, to prevent serious or irreversible environmental degradation.

11. Contractors and suppliers
To promote the adoption of these principles by contractors acting on behalf of the enterprise, encouraging and, where appropriate, requiring improvements in their practices to make them consistent with those of the enterprise; and to encourage the wider adoption of these principles by suppliers.

12. Emergency preparedness
To develop and maintain, where significant hazards exist, emergency preparedness plans in conjunction with the emergency services, relevant authorities and the local community, recognizing potential transboundary impacts.

13. Transfer of technology
To contribute to the transfer of environmentally sound technology and management methods throughout the industrial and public sectors.

14. Contributing to the common effort
To contribute to the development of public policy and to business, governmental and intergovernmental programmes and educational initiatives that will enhance environmental awareness and protection.

15. Openness to concerns
To foster openness and dialogue with employees and the public, anticipating and responding to their concerns about the potential hazards and impacts of operations, products, wastes or services, including those of transboundary or global significance.

16. Compliance and reporting
To measure environmental performance, to conduct regular environmental audits and assessments of compliance with company requirements, legal requirements and these principles; and periodically to provide appropriate information to the Board of Directors, shareholders, employees, the authorities and the public.

## Support for the Charter

The ICC is undertaking an extensive campaign to encourage member companies and others to express their support for the Charter. It has also invited certain international organizations to provide supportive messages.

A list of these companies, and the messages received from international organizations are given in separate leaflets which are normally circulated together with the Charter. They may also be obtained from ICC Headquarters or ICC National Committees in nearly 60 countries.

**The Business Charter for Sustainable Development was adopted by the 64th Session of the ICC Executive Board on 27 November 1990, and first published in April 1991.**

**It was prepared for the ICC Commission on Environment - Chairman Torvild Aakvaag (Norsk Hydro) - by the Commission's Working Party on Sustainable Development**

**Chairman Peter Bright (Shell International)**
**Vice-Chairman W Ross Stevens III (Du Pont)**

**The ICC is indebted to numerous companies and business organizations for their input in preparing the Charter. For further information on this project, contact Nigel Blackburn at ICC Headquarters, Paris**

The Business Charter for Sustainable Development was prepared by the ICC in 1990 for launching at the Second World Industry Conference on Environmental Management (WICEM II) in April 1991. It provides a basic framework of reference for action by individual corporations and business organizations throughout the world.

The Charter is also published by the ICC in Dutch, French, German, Portuguese and Spanish. Other editions are in preparation, or may be available from ICC National Committees.

**For further information in the UK about the Charter and other aspects of the ICC's work on the environment, please contact:**

**Rodney Sutton, Director**
**ICC UNITED KINGDOM**
**14/15 Belgrave Square**
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ICC
**International Chamber of Commerce**
**The world business organization**
**38, Cours Albert 1er - 75008 Paris France**
**Tel (33)(1) 49 53.28.28, Fax. (33)(1) 42 25 86 63**
**Telex: 650770F**

**Publication 210/356 A**

Annexure 4

# STRATEGY FOR ENERGY MANAGEMENT

- **SET HIGH STANDARDS**
- **SET UP DEPTL TASK FORCES**
- **SET MBO TARGETS**

## 1. ELIMINATE WASTAGE

- ZERO-LEAK PLAN
- LLF(LOOK, LISTEN, FEEL)
- REPORT AND MONITOR STEAM, WATER AND AIR LEAKS
- MINIMISE IDLE RUNNING TIME
- MAXIMISE THROUGHPUTS
- SERVICE/REPLACE FAULTY TRAPS

## 2. IMPROVE STEAM GEN EFFICIENCY

- BOILER CONTROLS- EXCESS AIR, UNBURNT RESIDUE, DEAERATION, BLOWDOWN
- CONDENSATE RECYCLE
- SWITCH TO 100% COAL - INSTALL ESP
- AVOID IDLE RUNNING OF AUXILIARIES
- FUEL ADDITIVES
- ALTERNATIVE FUEL(HUSK/WOOD/ BAGGASE/SAW DUST)
- FUEL QUALITY

## 3. MODIFY PROCESS CONDITIONS

- STOP IDLE PUMPS
- RECYCLE WATER/OIL
- RECOVER FLASH VAPOURS
- STAGGER CT TOWER FANS/PUMPS

## STRATEGY FOR ENERGY MANAGEMENT(CONTD.)

**4. IMPROVE ELECTRICAL CONTROLS**

- RATIONALISE MOTOR LOADING
- VVF DRIVES

**5. IMPROVE OPERATING PRACTICES**

- OPTIMISE STEAM USAGE IN OIL HANDLING AND STORAGE
- SWITCH OFF LOADS NOT REQUIRED

**6. REPLACE INEFFICIENT EQUIPMENT**

- REPLACE INEFFICENT PUMPS/ COMPRESSORS
- INSULATED TANKERS

**7. DOWNSIZE/REORGANISE OPERATIONS**

- EXTRA PACKING LINES
- REVIEW/OPTIMISEOPEARATING DAYS/WK
- CAMPAIGN OPERATION

**8. UPGRADE DESIGNS**

- INSULATE TANKS
- IMPROVE INSULATION
- RECOVER PROCESS CONDENSATE WHEREVER POSSIBLE
- EVALUATE CONTINUOUS OPERATION TO REPLACE BATCH OPERATION
- INSTALL 'PINCH' EXCHANGERS

Annexure 5

# SAMPLE OF ENCON IDEAS

* Upgrade Mazzoni Throughputs from
2.5 TPH to 3.6 TPH

* Effecient vacuum system for Mazzoni
- Single ejector/double stage vacuum pump

* Tank Insulation/Insulated tankers

* Pinch exchangers for DFA Plants

* Condensate heat recovery

* Thermosyphoning for Gly evaporation

* Upgrading NSD Bar Plodders

* Use of DFA residue as fuel

* Auto temperature control for Cooling Towers

* Low Energy Plodders(LEP) for soaps

* Rationalisation of electrical drives

* Fuel substitution

# Annexure 6

## TYPICAL ENERGY CONSERVATION ACTION PLAN

** = Econ CP

| No | Description | Action By | Target Date | Status |
|---|---|---|---|---|
| A | DFA Plant | | | |
| 1 | Vac. System : Upgradation<br>- Give details & obtain quoates For 1 & 2 stages.<br>- or replace Nozzles on immediate basis | DDM / AS<br>DDM / AVD | 25/04<br>05/05 (PO) | PO raised |
| 2 | Activate Temp. Control of Precut column feed /Thermiac Fluied. | DDM / SBN | 25/04 | Done |
| 3 | Install RTD type temp. indicators on Heat Exchage points. | DDM / SBN | 25/04 | Po raised, 3nos. already obtained |
| 4 | Eliminate steam leakages and sustain. | DDM / AS | 08/04 On Going | Done regularly |
| 5 | DFA operations : Run Evaporation and Distillation on campaign basis. | DDM | Cont. | |
| 6 | Examine Spilt Blend option | AA/CM/BBD/ SP | 10/04 | ---- |
| 7 | Recycle Sweet water to splitting Column. | DDM / MSK | 15/05 | Not advisable |
| 8 | Feed condensate to Splitting Column by Direct feed from Cond. Pump - Suc. of HP pump. | DDM / MSK | 20/04 | Done |

| No | Description | Action By | Target Date | Status |
|---|---|---|---|---|
| B | Tank Farm - | | | |
| 1 | Rationalise Tanks and Blank steam line going to idle tanks. | NS/AS/MSK | 10/04 | Done |
| 2 | Insulate all operating tanks - Identify and estimate surface area.<br>- Raise CP. | DDM /AVD | 15/04<br>** | ----- |
| 3 | Use condensate in coils for heating purpose in all tanks except HRI. Provide necessary piping and pumping facitilty. | AS / MSK | 30/04 | Started in Oil blend tanks |
| 4 | Get insulated tankers plying from Bombay to VDL | AA | 10/05 | ----- |
| 5 | Insulate pump suction lines. | MSK | 25/04 | In progress |
| 6 | Eliminate steam leakages. | AS / MSK | 08/04 | Done regularly |
| C | Toilet Soap Plant - | | | |
| 1 | Vac. System - Inspect & if necessary upgrade ejector design. | NS / AG | 10/04 | Inspected. |
| 2 | Examine & Collect steam condensate and route to DFA cond. tank. | AVD | 30/04 | In progress |
| 3 | Rationalise Steam piping in crutcher section. | AVD /AS | 01/06 | ----- |
| 4 | Eliminate steam leakages. | NS | 08/04 | Done regularly |
| D | NSD Powder - | | | |
| 1 | Evaluate the following to increase plant capacity :<br>- HAG de-bottlenecking<br>- ID fan Capacity<br>- Increase Hot air inlet temp. to 400 Deg. C. | AVD / PVK | evaluate 10/04 based on outcome plan | |

| No | Description | Action By | Target Date | Status |
|---|---|---|---|---|
| 2 | Examine use of Viscosity modifier for reducing moisture content slurry feed below 38 %. | CM /BBD | 25/04 | ----- |
| E | Utilities - | | | |
| 1 | Cooling Water System :<br>- Rationalse cooling water / pumps<br>- Replace fans with FRP blades<br>- raise CP | AVD/AS/DDM<br>AVD /AS | 10/04<br>** | Done<br>----- |
| 2 | Boilers :<br>- Achieve single boiler operation on sustained basis.<br>- Recyle condensate in HP boiler with proper control over pH and TDS. | DDM / AS<br>AVD /DDM /AS | Cont.<br>15/05 | ----<br>In Progress |
| 3 | Electricals<br>- Rationalise big size motors eg. 40 HP Plodder Motors to 30 HP - TSP<br>- Improve PF up to 0.97 by monitoring Capcitor Banks in necessary install additional banks at right place.<br>- Replace HPMV lamps ( street lighting ) by HPSV<br>- Replace Dynodrives with VVVF drives.Raise CP.<br>- Replace ordinary chokes with electronic chokes in phased manner<br>- Provide interlocks on cascade conveyors | NS/AG/SBN<br>AVD /SBN<br>SBN / AS<br>AVD/DDM/AS<br>SBN<br>SBN | 15/05<br>**<br>30/05<br>**<br>cont.<br>15/04 | |
| F | Sulhonation Plant : | | | |
| 1 | Dont run the plant and consider disposal of LAB. | CM /AA | 02/04 | Non-operational |

| No | Description | Action By | Target Date | Status |
|---|---|---|---|---|
| G | General | | | |
| 1 | - Provide Steam meters at<br>* Generation points - 2nos<br>* Tank Farm<br>- Replace faulty Conditioning unit of NSD powder plant.<br>- Start logging steam consumption on daily basis. | AVD / AS | **<br>05/05<br>15/04<br>Cont. | |
| 2 | Report steam leaks plant wise on weekly basis. | AS | Cont. | Done |
| 3 | Report energy consumptions against standards on weekly basis. | AS | Cont. | Done |

Figure -4

# Energy savings resulted from ....

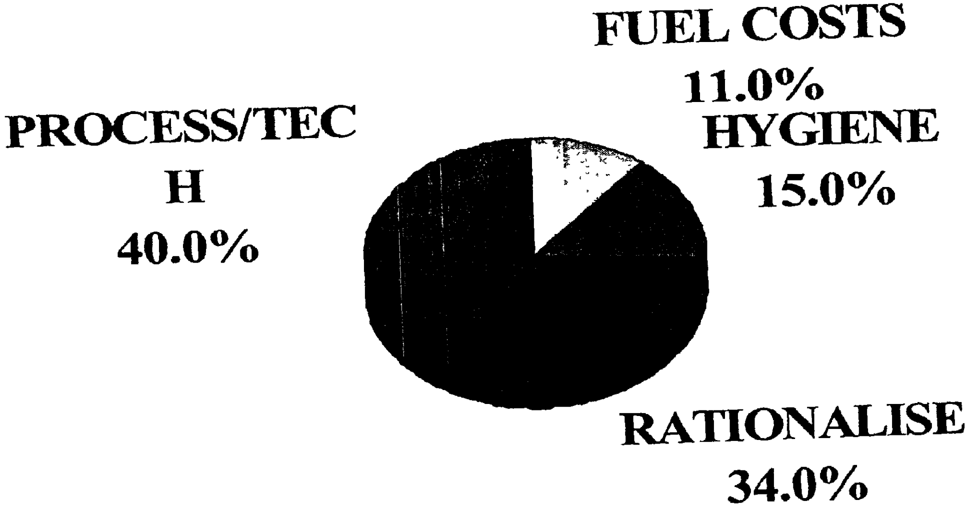

Table -3A

# TYPICAL COLLECTION OF BASE DATA FOR 1996

'ENERGY CONSUMPTION REPORT

UNIT : CALICUT FACTORY

MONTH : CUMULATIVE 1996

| 1. PRODUCTION (T) | MONTH | CUM '96 | 'TOTAL ENERGY CONSUMPTION | MONTH | CUM '96 | RATE PER UNIT (RS) (MONTH) |
|---|---|---|---|---|---|---|
| HARD SOAPS (LAUNDRY) | | 12,825.0 | GRID POWER (MWH) | | 487.2 | 1,818 |
| TOILET SOAPS (LB 150G) | | 780.1 | CAPTIVE POWER(MWH) | | 289.35 | 2,765 |
| PREMIUM SOAPS | | | TOTAL POWER (MWH) | | 776.55 | |
| SOAP NOODLES | | | FURN ACE OIL ( KL) | | 593.2 | 6,917 |
| NSD BAR | | | HSD (KL) | | 109.6 | 9,236 |
| NSD POWDER | | | COAL (T) | | | |
| DFA | | | OTHER FUEL (KL) | | | |
| CRUDE GLYCERINE | | | | | | |
| REF GLYCERINE | | | STEAM | 885.3 | 6,472.2 | 688 |
| SULPHONIC ACID | | | | | | |
| OTHERS(SPECIFY) | | | | | | |

2 'SPECIFIC CONSUMPTION AND CONVERSION EFFICIENCY

CONSUMPTION / T PRODUCT

| PRODUCT / CATAGORY | STEAM T/ T | POWER KWH/ T | OTHERS LIT/ T | FURN OIL PER KL | COAL PER T |
|---|---|---|---|---|---|
| HARD SOAPS | 0.593 | 48.1 | STEAM T | 0.09 | |
| TOILET SOAPS | 0.593 | 48.1 | POWER KWH | 0.30 | |
| PREMIUM SOAPS | | | | | |
| SOAP NOODLES | | | | | |
| NSD BAR | | | STEAM PR | KG /CM2 G | 10.54 |
| NSD POWDER | | | STM TEMP | DEG C | 188 |
| DFA | | | | | |
| CRUDE GLYCERINE | | | COAL TO | FOR CAPTIVE | |
| REF GLYCERINE | | | FUEL RATIO | T/ KL | |
| SULPHONIC ACID | | | | | |

| | MONTH | CUM '96 |
|---|---|---|
| 4 TOTAL COSTS RS '000 | | 4,652.0 |
| 5 TOTAL ENERGY BILL RS '000 | 608.8 | 4,849.8 |

REMARKS :

Production categorywise: MT

| | |
|---|---|
| Lifebuoy 150g | 780.1 |
| 501 H.Bar | 6719.2 |
| OK (W) 200g | 6105.8 |
| Purchased energy consu | 487.2 |
| F Oil | 557.6 |
| Diesel Oil | 109.6 |
| Captive power generatio | 289.3 |

Total energy cost:

| | |
|---|---|
| Purchased (Rs Lakhs) | 7.54 |
| Captive po | 9.53 |
| F.Oil | 36.88 |
| Diesel Oil | Shown in captive power |

PREPARED : P.B. JAYAKUMARAN CHECKED :

## Table - 3B

## OVEARLL ENERGY DATA BASE FOR 1996

### DETERGENT FACTORIES

| | Cost Rs L | Vol T | Sp cost R | Kwh/T | 000'Kcal/T |
|---|---|---|---|---|---|
| UNIT | 96 ACT | 96 VOL | 96 ACT | 96 ACT | 96 ACT |
| BF | 1095.00 | 70955.00 | 1543.23 | 203.00 | 1791.00 |
| GRF | 1134.00 | 106435.00 | 1065.44 | 172.00 | 1441.00 |
| OF | 834.00 | 58313.00 | 1430.21 | 172.00 | 2155.00 |
| KHF | 834.00 | 71322.00 | 1169.34 | 162.00 | 1052.00 |
| TATA | 261.00 | 28770.00 | 907.19 | 112.00 | 883.00 |
| VDL | 672.00 | 42505.00 | 1580.99 | 205.00 | 1107.00 |
| GZD | 451.00 | 20972.00 | 2150.49 | 263.00 | 1460.00 |
| RJF | 328.00 | 62005.00 | 528.99 | 70.00 | 441.00 |
| CHF | 216.00 | 81106.00 | 266.32 | 73.00 | 0.00 |
| DAB | 283.00 | 13295.00 | 2128.62 | 221.00 | 2073.00 |
| AUR | 154.00 | 5982.00 | 2574.39 | 238.00 | 3147.00 |
| CAL | 54.00 | 13605.00 | 396.91 | 57.00 | 400.00 |
| SF | 65.00 | 40411.00 | 160.85 | 48.00 | 0.00 |
| MANG | 59.00 | 41135.00 | 143.43 | 49.00 | 0.00 |
| GAJ | 50.00 | 25821.00 | 193.64 | 53.00 | 0.00 |
| POND | 24.00 | 14961.00 | 160.42 | 83.00 | 0.00 |
| MAD | 60.00 | 6828.00 | 878.73 | 97.00 | 790.00 |
| NLL | 66.50 | 7530.00 | 883.13 | 173.00 | 412.00 |
| HAYB | 43.00 | | | | |
| TOTAL | 6683.50 | 711951.00 | 947.52 | 131.00 | 1358.00 |

TABLE - 4

## TYPICAL ENERGY CONSUMPTION REPORT

UNIT . KHAMGAON — MONTH · MAY 1997

1

| PRODUCTION (T) | MONTH | CUM '97 | TOTAL ENERGY CONSUMPTION | MONTH | CUM '97 | RATE PER UNIT (RS) |
|---|---|---|---|---|---|---|
| | | | POWER (PEARS) KWH | 88510 | 449081 | 3.32 |
| HARD SOAPS | 2514 | 11723 | POWER (SF) KWH | 874751 | 3777465 | 3 32 |
| TOILET SOAPS | 4077 | 16492 | PROJECT POWER-KWH | 23783 | 115912 | 3.32 |
| PREMIUM SOAPS | | | TOTAL POWER (MWH) | 987044 | 4342458 | 3.320 |
| SOAP NOODLES | | | FURN ACE OIL-SF- ( KL) | 450 | 2551.871 | 6996 |
| NSD BAR | | | FO - PEAR- ( KL) | 30.545 | 163.011 | 6996 |
| NSD POWDER | | | TOTAL FO (KL) | 480.545 | 2714.882 | |
| DFA | | | OTHER -LDO (KL) | 0.000 | 18 657 | 9802 |
| CRUDE GLYCERINE | 0 | 121.385 | | | | |
| REF GLYCERINE | | | STEAM (T) | 5038 | 29545 | 685 00 |
| SULPHONIC ACID | | | WATER -SF (T) | 12643 | 64891 | 21 |
| OTHERS( PEARS) | 180 | 665.223 | WATER -PROJ (T) | 840 | 4470 | 21 |

2 'SPECIFIC CONSUMPTION AND CONVERSION EFFICIENCY

| PRODUCT / CATAGORY | CONSUMPTION / T PROD STEAM T/ T | POWER KWH/ T | WATER T/T | | CONVERSION EFFICIENCY FURN OIL PER KL | COAL PER T |
|---|---|---|---|---|---|---|
| HARD SOAPS | 0.674 | 80 | 1.90 | STEAM T | | |
| TOILET SOAPS | 0 738 | 165 | 1.93 | POWER MWH | | |
| PREMIUM SOAPS | | | | | | |
| SOAP NOODLES | | | | | | |
| NSD BAR | | | | STEAM PR | KG /CM2 G | |
| NSD POWDER | | | | STM TEMP | DEG C | |
| DFA | | | | | | |
| CRUDE GLYCERINE | 0 | 0 | | COAL TO | FOR CAPTIVE | |
| REF GLYCERINE | | | | FUEL RATIO | T/ KL | |
| SULPHONIC ACID | | | | | | |
| PEARS | 1.869 | 492 | | | | |

3 ENERGY COSTS FOR THE MONTH

| | STEAM RS '000 | POWER RS '000 | WATER RS '000 |
|---|---|---|---|
| HARD SOAPS | 1161 | 668 | 94 |
| TOILET SOAPS | 2061 | 2233 | 155 |
| PREMIUM SOAPS | 0 | 0 | |
| SOAP NOODLES | 0 | 0 | |
| NSD BAR | 0 | 0 | |
| NSD POWDER | 0 | 0 | |
| DFA | 0 | 0 | |
| CRUDE GLYCERINE | 0 | 0 | 0 |
| REF GLYCERINE | 0 | 0 | |
| PROJECT | 0 | 79 | 18 |
| PEARS | 230 | 294 | |

| | MONTH | CUM '97 | REMARKS . |
|---|---|---|---|
| 4 TOTAL COSTS RS '000 | 6993 | 34454 | |
| 5 TOTAL ENERGY BILL RS '000 | 6993 | 34454 | |
| 6 TOTAL ENERGY INPUT (GJ) | | 0 | |

PREPARED : CHECKED ·

#VALUE!

**Table -5**

## ENERGY REPORT FORMAT FOR EACH UNIT

## HINDUSTAN LEVER LIMITED

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **UNIT:** | | | **MONTH:** | | 1997 | |
| | | **ENERGY CONSUMPTION REPORT** | | | | | |
| 1 | **PRODUCTION (T)** | | | **TOTAL ENERGY CONSUMPTION** | | | RATE PER |
| | | MONTH | CUM'97 | | MONTH | CUM'97 | UNIT (RS) |
| 1 | HARD SOAPS | | | | | | FOR MONTH |
| 2 | TOILET SOAPS | | | | | | |
| 3 | PREMIUM SOAPS | | | GRID POWER (KWH) | | | |
| 4 | HS NOODLES | | | | | | |
| 5 | TS/PS NOODLES | | | CAPTIVE POWER(KWH) | | | |
| 6 | NSD BARS | | | TOTAL POWER (KWH) | | | |
| 7 | NSD POWDERS | | | FURN ACE OIL ( KL) | | | |
| 8 | PEARS | | | HSD (KL) | | | |
| 9 | DFA | | | COAL (T) | | | |
| 10 | CRUDE GLYCERINE | | | LDO (KL) | | | |
| 11 | REF GLYCERINE | | | OTHER FUEL (KL) | | | |
| 12 | SULPHONIC ACID | | | | | | |
| 13 | OTHERS(SPECIFY) | | | | | | |
| 14 | OTHERS(SPECIFY) | | | STEAM (T) | | | |
| | TOTAL | | | | | | |
| | | | | | | | |
| 2 | **'SPECIFIC CONSUMPTION AND CONVERSION EFFICIENCY** | | | | | | |
| | | CONSUMPTION / T PRODUCT | | | | | |
| | PRODUCT / CATAGORY | STEAM | POWER | DIRECT FUEL | RATE -RS/LIT | REMARKS | |
| | | T/ T | KWH/ T | LIT/T | | | |
| 1 | HARD SOAPS | | | | | | |
| 2 | TOILET SOAPS | | | | | | |
| 3 | PREMIUM SOAPS | | | | | | |
| 4 | HS NOODLES | | | | | | |
| 5 | TS/PS NOODLES | | | | | | |
| 6 | NSD BARS | | | | | BOILER EFF | |
| 7 | NSD POWDERS | | | | | DG EFF | |
| 8 | PEARS | | | | | | |
| 9 | DFA | | | | | | |
| 10 | CRUDE GLYCERINE | | | | | | |
| 11 | REF GLYCERINE | | | | | | |
| 12 | SULPHONIC ACID | | | | | | |
| 13 | OTHERS(SPECIFY) | | | | | | |
| 14 | OTHERS(SPECIFY) | | | | | | |
| | OVERALL | | | | | | |
| 3 | **ENERGY COSTS FOR THE MONTH** | | | | | | |
| | | STEAM | POWER | DIRECT FUEL | TOTAL COST | SP COST RS | CUM'97 |
| | | RS '000 | RS '000 | RS '000 | RS'000 | MONTH | |
| 1 | HARD SOAPS | | | | | | |
| 2 | TOILET SOAPS | | | | | | |
| 3 | PREMIUM SOAPS | | | | | | |
| 4 | HS NOODLES | | | | | | |
| 5 | TS/PS NOODLES | | | | | | |
| 6 | NSD BARS | | | | | | |
| 7 | NSD POWDERS | | | | | | |
| 8 | PEARS | | | | | | |
| 9 | DFA | | | | | | |
| 10 | CRUDE GLYCERINE | | | | | | |
| 11 | REF GLYCERINE | | | | | | |
| 12 | SULPHONIC ACID | | | | | | |
| 13 | OTHERS(SPECIFY) | | | | | | |
| 14 | OTHERS(SPECIFY) | | | | | | |
| | TOTAL | | | | | | |
| | | | | | | | |
| | | | 'MONTH | CUM'97 | | REMARKS | |
| 4 | **TOTAL COSTS (RS '000)** | | | | | | |
| | | | | | | | PER T-CUM |
| 5 | **TOTAL ENERGY INPUT(GJ)** | | | | | PER T-MONT | |
| | - POWER | | | | | | |
| | - FUELS | | | | | | |
| | -TOTAL GJ | | | | | | |
| | | | | | | | |
| | PREPARED | | | CHECKED | | | |
| | | | | | | | |
| | | | | | | | |

Table - 6A

## ENERGY EFFICIENCY REPORT - AUG 1997

DETERGENT FACTORIES

COSTS RS LAKHS

| UNIT | VOL ACT | PRORAT FOR MO | AUG ACT | DIFF |
|---|---|---|---|---|
| BF | 5040.60 | 83.19 | 90.80 | 7.61 |
| GRF | 7579.00 | 98.40 | 85.10 | -13.30 |
| OF | 5617.00 | 85.95 | 75.00 | -10.95 |
| KHF | 5617.00 | 71.64 | 68.10 | -3.54 |
| TATA | 2763.00 | 27.85 | 24.40 | -3.45 |
| VDL | 5676.00 | 94.68 | 66.70 | -27.98 |
| GZD | * | 34.69 | 6.80 | -27.89 |
| | | | | |
| RJF | 4330.00 | 23.28 | 20.60 | -2.68 |
| CHF | 5195.90 | 14.64 | 15.70 | 1.06 |
| DAB | 1102.00 | 27.29 | 14.60 | -12.69 |
| AUR | 688.20 | 19.57 | 17.40 | -2.17 |
| CAL | 1405.10 | 6.77 | 5.00 | -1.77 |
| | | | | |
| SF | 3004.20 | 6.86 | 4.37 | -2.49 |
| MANG | 3948.60 | 6.02 | 5.40 | -0.62 |
| GAJ | 1234.00 | 2.43 | 3.55 | 1.12 |
| POND | 3586.00 | 5.99 | 4.42 | -1.57 |
| MAD | * | 5.80 | 1.30 | -4.50 |
| NLL | 966.40 | 8.38 | 10.40 | 2.02 |
| HAYB | * | 3.60 | 3.95 | 0.35 |
| TOTAL | 57753.00 | 627.05 | 523.59 | -103.46 |

SP COST RS/T

| UNIT | 96 ACT | AUG ACT |
|---|---|---|
| BF | 1650.47 | 1801.37 |
| GRF | 1298.30 | 1122.84 |
| OF | 1530.25 | 1335.23 |
| KHF | 1275.46 | 1212.39 |
| TATA | 1008.06 | 883.10 |
| VDL | 1668.12 | 1175.12 |
| GZD | 2358.00 | * |
| | | |
| RJF | 537.60 | 475.75 |
| CHF | 281.70 | 302.16 |
| DAB | 2476.82 | 1324.86 |
| AUR | 2843.10 | 2528.33 |
| CAL | 482.06 | 355.85 |
| | | |
| SF | 228.30 | 145.46 |
| MANG | 152.52 | 136.76 |
| GAJ | 197.03 | 287.68 |
| POND | 167.09 | 123.26 |
| MAD | * | * |
| NLL | 867.53 | 1076.16 |
| HAYB | * | * |
| TOTAL | 1085.75 | 906.60 |

Table - 6B

## ENERGY EFFICIENCY REPORT - AUG 1997

### DETERGENT FACTORIES

SP POWER KWH/T

| UNIT | 96 ACT | AUG ACT | % DIFF |
|---|---|---|---|
| BF | 203.00 | 222.80 | 9.75 |
| GRF | 172.00 | 146.90 | -14.59 |
| OF | 172.00 | 155.50 | -9.59 |
| KHF | 162.00 | 164.30 | 1.42 |
| TATA | 112.00 | 118.70 | 5.98 |
| VDL | 205.00 | 142.90 | -30.29 |
| GZD | * | * | ERR |
| RJF | 70.00 | 72.90 | 4.14 |
| CHF | 73.00 | 85.40 | 16.99 |
| DAB | 221.00 | 148.80 | -32.67 |
| AUR | 238.00 | 189.60 | -20.34 |
| CAL | 57.00 | 45.50 | -20.18 |
| SF | 48.00 | 50.20 | 4.58 |
| MANG | 49.00 | 42.00 | -14.29 |
| GAJ | 53.00 | 69.70 | 31.51 |
| POND | 83.00 | 59.60 | -28.19 |
| MAD | | | |
| NLL | 173.00 | 193.70 | 11.97 |
| HAYB * | | | |
| AVG | 130.69 | 119.28 | -8.73 |

SP FUEL '000 KCAL/T

| UNIT | 96 ACT | AUG ACT | % DIFF |
|---|---|---|---|
| * BF | 1791.00 | 1966.10 | 9.78 |
| GRF | 1441.00 | 1282.30 | -11.01 |
| OF | 2155.00 | 1932.50 | -10.32 |
| KHF | 1052.00 | 816.80 | -22.36 |
| TATA | 883.00 | 861.50 | -2.43 |
| VDL | 1107.00 | 849.30 | -23.28 |
| GZD | * | * | ERR |
| RJF | 441.00 | 355.40 | -19.41 |
| CHF | | | |
| DAB | 2073.00 | 861.50 | -58.44 |
| AUR | 3147.00 | 2666.30 | -15.27 |
| CAL | 400.00 | 294.70 | -26.33 |
| SF | 0.00 | | |
| MANG | 0.00 | | |
| GAJ | 0.00 | | |
| POND | 0.00 | | -100.00 |
| MAD | | | |
| NLL | 450.00 | 515.60 | 14.58 |
| HAYB * | | | |
| AVG | 1358.18 | 1127.45 | -16.99 |

## Programme on Energy, Environment, Resources, and Sustainability (PEERS) – 1997/98

### Final Project Report

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# Sustainability in the textile industry with reference to dyes

*Submitted by*
**Ms Gauri S Trivedi**

**April 1998**

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PROGRAM ON ENERGY,
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ORGANISED BY TERI, NEW DELHI
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# PROJECT REPORT

# SUSTAINABILITY IN THE TEXTILE INDUSTRY WITH REFERENCE TO DYES

By
GAURI S. TRIVEDI IAS
General Manager - HHEC
New Delhi

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**GAURI S. TRIVEDI**, IAS
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## INTRODUCTION :

India has a long and rich tradition of producing a variety of textiles In the past, India had everything to offer to the world market, the finest raw material, the finest muslins, the best craftsmanship and the best dyes. Until the 18th century the art fabrics of India had enjoyed undisputed supremacy for 2000 years Indian skiens and muslins under the name of textile ventalis and woven air, were exported to Rome and prized as articles of luxury. In the 7th Century came the costly textiles manufactured by the tie & dye process in a variety of designs, in silk and linen, cloth fine as the serpent's Slough and the pearl-embroidered fabrics of special makes Indian muslins have been justifiably famous through the centuries and the Dacca weaver unquestionably occupied the finest place having never been beaten either in India or abroad. The forward quality of the yarn used in the manufacture of muslins intended for the court of Delhi is said to have been 150 cubits of length per 1.75 grains of weight. The mulmul had 1000 to 1500 threads in the wrap.

The craft of weaving accounted for the bread and butter part of India's export trade and traditionally provided employment for many families. Small looms were found in almost all villages where the local weaver satisfied the nearby markets' popular demand.

We cannot ignore the hard hitting fact that we lost this glory as soon as the East India Company took over the monopoly of Indian trade. Only cheap raw material started being produced for bigger profits. The company exercised its newly acquired political power to strangle the Indian weaving Industry. Various rigorous penalties were enforced for failure to make deliveries, and once the weaver took an advance he very seldom escaped his liability. The oppressive method of the Company made the condition of weavers miserable, and large numbers abandoned the loom for the plough. Later still, competition with foreign mill made cloth almost strangled the industry and it goes to the credit of the weaver that inspire of staggering odds he managed to keep his craft alive.

During the first half of the 19th Century in India the decentralised cotton industry was practically destroyed and India become dependent on England and Japan for her clothing requirements and it was only in the first decade of the later half of the century that the Indian cotton textile industry was born.

Due to all the previous wrong policies by the turn of the century we lost the past glory and India became a major producer for basic raw material and cheaper goods.

The scenario did not change much in post independent India. Even today India is one of the largest producers of textile goods in the world, but in quality and designs we have not been able to create a niche for ourselves in the international market. Our weaving industry is somehow managing to pull through because of favourable policies of the Govt. towards the handloom industry. The weavers are being given condensation in the form of raw material, tools equipments and domestic market assistance. Due to this reason we see today a large number of co-operative societies and, NGOs involved in this industry, The weavers service centres are being established to help the weavers in dyeing and designing. In these centres simple artists are working to develop designs for the weavers but these have failed to move towards any market direction The ultimate result is voluminous production deprived of value addition. It is here that the Government and certain institutional mechanism has to play a major role in pushing the textile industry into the new millennium by actually shouldering a major task of not only reviving the age old traditional techniques but also by sharing a major social responsibility that is sustaining the weaving industry by generating employment

The Textile Industry is the second largest industry, after agriculture in terms of number of persons employed. It employees around 38.11 million people. Besides employment generation, it also earns the nation substantial foreign exchange which accounts for nearly one-third of India's total foreign exchange earning During 1996-97 total textile and Clothing export was worth Rs. 40,000 crore approximately.

The Indian Textile Industry, in itself, is highly diversified. It ranges from the handmade traditional textile products in the cottage industry to the highly capital intensive, modern and sophisticated mill sector and synthetic fibre manufacturing units. In between these two extremes, lies a vast decentralised powerloom and knitting sector. Production-wise, the mill sector contributes about 7%, the handloom sector about 23% and the powerloom sector around 54% and the knitting sector 16%.

The textile industry has seen its ups and downs during the last two decades. From the manufacture of traditional items, the industry diversified to manufacture of fashion items. The garment industry made a phenomenal improvement in its exports. The total export of textiles had reached 11837.13 million U.S. Dollar during the year 1996-97 from 10685.07 million in the year 1995-96 Consequent upon Government's liberalization policy in the year 1991, the market is now exposed to global competition and quality. Prior to liberalization, the Indian Textile Industry was operating to exploit the comparative advantages such as production of more and more quantity of Handloom and handmade products, use of cheap labour, rural employment generation and earning of foreign exchange through exports.

It is now time to exploit competitive advantages of production of superior quality and high productivity Thus the Indian manufacturers and Exporters now have to compete with the global players and also have to face emerging tariff and non-tariff barriers. Further, awareness and general consciousness about ecological aspects in the manufacture and use of textiles has brought in several new dimensions to all the players in the textile sector.

In this pursuit, it is required to look at productivity, quality and environmental friendliness of both process and product. These needs are to be addressed by the manufacturers, exporters, support systems like Central and State agencies working in different areas/clusters, so that winning strategies could be developed for overall and healthy growth of textile sector.

## ECOLOGICAL ISSUES AND THE GERMAN BAN :

Ecological considerations are becoming important factors in the marketing of consumer goods including textiles all over the world. Exporters of textile goods must therefore be in a position to adopt their products and processing techniques to comply with new environmental regulations being introduced in their target / niche markets.

In the field of textiles, it is now realised that a number of dyes and chemicals being used by the industry, contain toxic and hazardous substances which not only affect the consumer but also cause irreparable damage to the environment. In this regard Germany has taken a lead and imposed a ban on the use of azo dyes containing harmful amines in the textile production.

The ban imposed by Germany on specific azo dyes releasing any of the twenty harmful amines has already come into force with effect from 1st April 1996. As per the provisions of the ban textiles dyed with the problematic dyes can not be sold in Germany (with effect from `st October, 1996). Violation of the ban will be dealt with severely by Germany.

Apart from Germany, Netherlands has also imposed a similar ban from 1st August, 1996 This is applicable to clothing, bed linen and footwear In accordance with this regulation, orders to exporters which were placed before 1st August, 1997 could be delivered to the Netherlands' consumers till September 1, 1998. Orders placed to exporters after August 1, 1997, however, will be subject to the new regulations. Similar action has been initiated by Sweden, Denmark, Canada and Norway.

As regards the German Ban on specific azo dyes releasing any of 20 harmful amines, as per the latest information available, an amendment to this law has been passed in the upper house of German Parliament and following changes have come into effect :

I) For leather and leather items the transition period for manufacture and import has been extended up to 31st March, 1997. For all other items, there is no change in the earlier deadline, i.e. 31st March, 1996.

ii) For all items, transition period for sale within Germany has been extended up to 31st December 1998. In other words items imported into Germany up to 31.3.1996 (up to 31.3.97 in case of leather and leather items) can be sold in the German market up to 31.12.98 even if these are not Azo-free.

iii) The 5th Amendment contains an exhaustive list of product categories covered by the ban on Azo Dyes.

iv) Carpets and wall-to-wall carpets have been excluded from the ban on Azo Dyes.

v) The category of pigments which do not split into hazardous Amines after their solvent treatment during the Analytical Test Method prescribed by German authorities, has been exempted from ban on Azo Dyes.

vi) As regards the Provisional Methods announced by German Ministry of health on the testing of Banned Amines released from textile products, the testing method has been finalised with minor changes.

vii) As regards re-cycled fibres, the transition period for the manufacture, import and domestic sales remains 31st December, 2000.

## WHAT ARE DYESTUFF :

Dyestuffs are made from synthetic organic chemicals which are called dyestuff intermediates. The intermediates are made from basic chemicals such as Benzidine, Naphthalene, Anthracine, etc. Therefore, the intermediates lie between basic chemicals and final dyestuff. The intermediates are nothing but the substituted products of basic chemicals obtained by introducing various groups like sulphuric, nitro, chloro, bromo, amino, etc., in the place of hydrogen atoms of the basic chemicals. Sometimes, reaction such as sulphanation, nitration, chlorination, etc., result in the formation of more than one product. In other words, if one of the desired products, is made some amount of an other always accompanies it. The presence of the subsidiary product with the main product may not be desired. When these by-products are found in different proportion in the dye manufactured, there will be variation in the tone and hue

## WHAT ARE THE DIFFERENT TYPES OF DYES :

In this paper I specifically will look at the need to change chemical dyes and Azoic dyes by sustituting them to natural dyes or at least dyes which are direct so that the entire process is sustainable and not harmful to human health and to the environment Before we look at substituting Azo dyes with natural dyes I would like to give the different kinds of dyes which are available at present.

1. Basic or cationic dyes which are synthetic dyes ionized with coloured component constituting the cation. Cationic dyes as they appear on the market are salts usually the chlorides but some times the oxalates or even double salts with zinc chloride.

2. Acid dyes that are so called because in the first place, the original members of the class were applied in a bath containing mineral or organic acid, and secondly, because they were nearly all sodium salts of organic acids and the anion is the active coloured component. Most of the acid dyes are sulphonic acid salts, but there are a few containing carboxyl groups.

3. The direct dyes, also known as the substantive colours, differ from the basic and acid dyes because they are strongly substantive towards cellulosic fibres. They are used in dyeing protin fibres and the majority are sulphonated azo compounds similar to acid dyes in constitution.

4. Mordant and Metal-Complex dyes are capable to combining with metallic oxides to form insoluble coloured lakes. Many of the old natural dyes such as alizarin, logwood, weld, and fustic were dyed on fibres which had previously been impregnated or mordanted with hydroxides of chromium, tin, or aluminium.

5. Azoic dyes are produced by coupling diazotized paranitroaniline with napthol. Azoic dyes as I will cover later in the paper contain sulphanic acid and split into two components during reduction reaction one of

which is the aryl amine. Some of these aryl amines are toxic or carcinogic in nature.

6. Sulpher dyes whose characteristic feature is that they all contain sulpher linkages within their molecules. They are usually insoluble in water but dissolve in a solution of sodium sulphide with sodium carbonate.

7. Dispurse dyes which are the easiest and commercially the most viable dyes in synthetic fibres They are made out of the acetylation of hydrophorbic fibre and are resistent to swelling as well as to acid dyes.

8. Finally there are the vat dyes which are the oldest natural colouring material used for textiles. Vat dyes are all insoluble in water and cannot be used for dyeing without modification such as treating them with reducing agents which convert them into leuco compounds soluble in water in the presence of alkalis.

## WHAT ARE THE BANNED AMINES :

The azo dyes constitute the largest and most varied group of synthetic organic dyes, with the fullest shade range. The relative ease and economy of preparation of azo dyes by the classic diazotisation and azo coupling reactions have led to the synthesis of many dyes. The fastness of azo dyes varies widely with structure and environment But in general, it tends to be less than that of anthraquinone vat dyes and indigo dyes and greater than that of sulphur dyes. Diazo compounds reactive with large number of coupling components to form azo derivatives. Nearly all direct dyes are azo dyes containing one or more sulphuric acid (as sodium salt) groups to impart water solubility. Most direct dyes contains two or three azo groups. Direct dyes of the ordinary type comprise a sizeable portion of the synthetic dyes. These are having the advantages of easy application and low value

When an azo dye undergoes reductions in some of the cases it will split into 2 components of which one is the aryl amine. Some of these aryl amines are reported to be toxic or carcinogenic in nature. However, in the present context 20 amines are banned as harmful as per the German Legislation. the list of 20 amines banned by Germany is given below :-

1. 4-Amino biphenyl (CAS-No.:92-67-1)
2 Benzidine (CAS-No 92-87-5)
3. 4-Chlor-o-toluidine (CAS-No.:95-69-2)
4 2-Naphthylamine (CAS No.:91-59-8)
5. p-Chloroaniline (CAS-No.:106-47-8)
6 2,4-Diaminoanisole (CAS-No 615-05-4)
7. 4,4'-Diamino diphenyl methane (CAS No.:101-77-9)
8. 3,3'-Dichloro benzidine (CAS-No.:91-94-1)
9. 3,3'-Dimethoxy benzidine (CAS-No.:119-90-4)
10. 3,3'-Dimethyl benzidine (CAS-No 119-37-7)
11. 3,3'-Dimethyl-4,4'-diamino diphenyl methane (CAS-No.:838-88-0)
12. p-Cresidine (CAS-No.:120-71-8)
13. 4,4'-Methylene-bis-(2-chloraniline) (CAS No.:101-14-4)
14. 4,4'-Oxydianiline (CAS-No :101-80-4)
15 4,4'-Thiodianiline (CAS-No.:139-65-1)
16. o-Toluidine (CAS-No.:95-53-4)
17. 2,4-Diamino toluene(CAS-No.:95-80-7)
18 2,4,5-Trimethyl aniline (CAs-No..137-17-7)
19. o-aminoazotoluene (CAS-No.:97-56-3)
20. 2-amino-4-nitrotolune (CAS-No.:99-55-8)

The following 4 amines have been proved to be highly carcinogenic :

I) 4-Aminodiphenyl
ii) Benzidine
iii) 4-Chlor-o-toluidine
iv) 2-Naphthylamine

The remaining 16 amines are also having carcinogenic and other harmfu effects on the human skin as per the experiments conducted recently. Apar from these 20 amines, 2 more amines are also suspected to be having the carcinogenic property. These are P-Amino Azo benzene and 2-Methoxy Aniline. However, these two amines have not yet been included in the banned category. However, it is expected that these two amines and additional amines may be added to the banned category in due course.

Although 20 amines are baned as per the German legislation, all these amines are not released from the 118 banned dyes, the list of which is given in Annexure. In fact only 12 of the 20 banned amines are released from these banned dyes There are :

I) Benzidine
ii) 4-Chlor-o-toludine
iii) o-Naphtyl amine
iv) o-Amino azo toluene
v) p-Amino azo benzene
vi) 2-Methoxy aniline
vii) 2-Amino-4-nitro toluene
viii) 3,3-Dimethoxy benzidine
ix) Dichloro benzidine
x) o-Toludine
xi) 3,3-Dimenthyl benzidine
xii) 4-Methyl-1, 3-Phenylenediamine.

## GERMAN REGULATION AND ITS IMPLICATIONS :

The eco regulations are imposed by Germany due to one or more of the following reasons :

I) increasing awareness about today's and future environmental problems posed by the textile industry and its products.

ii) Noticeable increase in the number of textile related allergies being reported.

iii) Fashion designers and marketing personnel all over the world have run out of ideas and wanted some new slogan to boost the sales of textiles (May be ! ).

iv) Problems faced in disposing of used textile goods by the European countries, particularly Germany, where the per capita consumption of textiles is as high as 11 Kgs. of apparels and 28 Kgs. of textiles including home textiles, from the point of view of ecological aspects.

Exports of Indian goods to various countries has been on the increase year after year. Germany stands as the second largest importer of textile items from India next only to United States of America. The ban imposed by Germany has become a lead for other countries like Netherlands. Developed countries are highly conscious of health hazards and ecological aspects.

Further, carcinogenic dyes are equally dangerous for handling in any country including India. Therefore, the twin issues to consider for the manufacture of eco friendly textiles are :

I) To have sustainable export both by value and quantum by India.

ii) To contain similar ecological problems identified and posed by Germany in the indian environment also.

## SOME OF THE ECO FRIENDLY CONSIDERATION FOR THE INDIAN TEXTILE INDUSTRY :

The main issue as far as, the Indian Textile Industry is the prohibition of the use of certain dyes and textile auxiliaries which contain these banned amines and other toxic substances. At present, the industry in India including Mill Sector, Powerloom, Handloom, Process Houses and even Khadi Village Industries are using these harmful substances either for enhancing aesthetic appeal or for imparting certain desirable characteristics to the textiles. These toxic materials are being used in several textile processes such as sizing, scouring, bleaching, dyeing and finishing. The textile industry is using around 8000 different chemicals in the manufacture of various goods. The list of toxic and harmful substances used by the industry is given in the following Table :

## LIST OF TOXIC AND HARMFUL SUBSTANCES USED BY TEXTILE INDUSTRY:

| Sr No. | Textile Process | Toxic Substance Used |
|---|---|---|
| 1 | Cotton growing | Banned pesticides such as DDT, Dieldrin, Aldrin, etc |
| 2 | Wool Storing | Banned insecticides |
| 3 | Silk worm culture | Banned pesticides |
| 4 | Sizing | Pentachlorophenol as preservatic |
| 5 | Scouring | Chlorinated products |
| 6 | Bleaching | Hypochlorite (chlorine bleaching) |

| | | |
|---|---|---|
| 7 | Dyeing & Printing | I) Azo-dyes containing aromatic Amines.<br>ii) Dyes containing traces of heavy metals such as Arsenic, Lead, Cadmium, Mercury, Nickel, Copper, Chromium, Cobalt and Zinc<br>iii) Formaldehyde as mordant |
| 8 | Finishing | Formaldehyde as a cross linking finish, urea formaldehyde as F R. finish |
| 9 | Garmet Manufacture | Stain removers containing products |
| 10 | Packaging | Wooden boxes treated with insecticides |

The industry will have to start using alternative dyes and textile auxiliaries in the place of the conventional ones which contain the above listed toxic materials which are carcinogenic in character and allergenic by nature.

The industry will have to adopt a cradle to grave apprach, for the manufacture of eco-friendly textiles, i e. the industry should start applying eco-prescriptions right from the stage of cultivation/production of fibres and also during spinning, weaving, chemical processing, garment manufacture and even packaging as per the guidelines given below :

Cotton is a highly pest prone crop. During cultivation cotton plant is sprayed with different types of pesticides some of which are very harmful. The farmers should be advised to use only permissible pesticides such as neem oi, permethin, etc They should be advised to avoid banned pesticides.

While storing wool fibre only permitted insecticides are to be used.

During silk worm culture pesticides are not to be used.

- In weaving and knitting care should be taken in the selection of lubricant, antistatic agents and other ingredients by ensuring that they do not contain prohibited chemicals.

- Chemical processing involves highest possibilities of contamination. The need is to avoid heavy metal traces which are likely to be present in certain dyestuffs and chlorinated products containing scouring aids and stain removers. Use of formaldehyde which is likely to be present in dye fixing agents, softeners and cross linking finishes and also as preservatives in many formulations is to be avoided In order to reduce the use of toxic chemicals in the finishing of textiles, alternative mechanical and high temperature processing is to be adopted wherever possible. Further, the use of natural dyes which are free rom toxic materials should be encouraged.

- During garment manufacture, stain removers containing chlorinated products and spray system with Chloro Fluro Carbon (CFC) and fluorides must be avoided

- For packaging environmentally friendly materials which can be taken back for re-use or recycling should be used. Further packing material used should be minimum in order to reduce the unnecessary waste in the importing country. It is to be noted by the exporters that wooden crates treated with insecticides are not acceptable to certain importing countries like Germany.

**NATURAL DYES :**

While Germany has only banned the use of Azo dyes because they contain amines, it may be seen that even the other dyes have certain compounds and characteristics which are harmful to the environment though they may not pose a serious health hazards to human beings. In the circumstances there has to be a move to substitute all the dyes listed above with the natural dyes. Natural dyes can be divided in two groups : those which will produce a fast colour just by boiling and those which need an additional chemical to make the colour permanent. The first group is known as substantive or non-mordant dyes, the second group adjective or mordant dyes. Mordant dyes are ones in which a chemical is fixed on the fibre as well as combined with the dye stuff and therefore a link is formed between dyestuff and fibres which allowes certain colours with no affinity for the fibre to be fixed. Such dyes are lichen and wallnuts and the mordants used are alum, chrome, iron and tin. The adjective dyes are bark. roots, flowers, skins, berries, leaves and stems of flowering plants alongwith the flowers, as well as leaves and stalks of certain plants.

With the exception of a few which can be mordanted to nylon, natural dyes are not suitable for application to synthetic fibers. Therefore, comparison of their application characteristics must be restricted to those synthetic dyes suitable for application to cotton or wool.

Synthetic dyes are generally applied to these substrates with the aid of salt and their substantivity is, as a rule, quite high.

## NATURAL DYES : ARE THEY REALLY SUSTAINABLE ?

Historically the most common natural dyes have been indigo madder and cochineal which we may classify in the mordant dyes group. Indigo is a dye which is obtained from the leaves of the plant indigo fera tinctoria. It gives a beautifull bright blue when added with amonia and if we add any alkali it turns a bright yellow green. Cochineal is extracted from the cochineal insect which is found in the cactus plants. It is a bright red and can be added with the mordants to make it pink, purple, scarlet or even violet in colour. Madder dye which comes from the roots of the madder plants found all over Europe and

Asia The colour range from beige to bright red but the process is very long and has as many as fourteen operations. All the three natural dyes that I have discussed are now regaining popularity but they all require a complicated process and great care and accuracy specially for mordanting. However, even these natural dyes are not completely substainable specially in the dyeing method which wholly manual and has remain unchanged for centuries For example, in the case of indigo holes in the ground are used for the dye-bath and the liquor is heated over open fires. Open air is used for oxidization and drying. Materials are readily available, many of them occuring naturally, and include natural fermentation products such as wood ashes which act as the reducing and alkali-solublizing agents. The annual worldwide demand for indigo is approximately 14,000 tons which would require 1.4 billion pounds of indigo leaves. Ninety eight percent of the leaves would become waste. If one is to take the term "natural" seriously, the indigo must be processed using a fermentation vat. This vat would be prepared, as it was prior to the availability of inorganic reducing agents, by fermentation of naturally occurring organic substances, such as plant parts, cow dung or urine. Madder is a challenging dyestuff to use wherein the colours are briliant and durable but require a lot of water which must be boiled slowly and also causes a lot of surplus mordant. Since it is required to be boiled slowly a lot of wood or coal is used in traditional dyeing methods and even in the most modern techniques much energy is wasted. A lot of water is also utilised as it has to be rinsed a minimum of six times and in a soapy solution also which causes effluence problems.

Madder is found beneath the outer bark of the roots when the plants are about three years old. At this age, the roots of the plant are only about one quarter inch in diameter and two feet long. The roots are dug, dried and pulverized to render a substance suitable for use. Only about two percent dye is obtained from the dried roots, here again, ninety eight percent of the roots and all of the rest of the plant are waste

Cochineal is an important red element for the natural dye user. It s the brightest of all the available natural red dyes. This dye is found in the cochineal louse which feed on cactus plants. Cochineal insects take three months to mature so a crop of about 90 Kg. per acre is usually collected during May, July and October. When the rainy seasons comes branches of cactus plants which are loaded with young insects are cut off and taken indoors to prevent the insects being destroyed by the stormy weather. The yield, under the best conditions, is about six pounds per acre of cacti. Production of a mere six millionpounds of dye would require at least one million acres of land.

One need only consider the small amount of colour contained in any of the sources of natural dyes to imagine the difficulties in obtaining adequate supplies to meet today's requirements for dyestuffs and the impact their harvest would have on the environment. An illustrative table is indicated below :-

**Yields of natural dyes**

| Dye | Sources | Content |
|---|---|---|
| Madder | Rootbark | 1.9% |
| Cochineal | Female Cochineal louse | 1.8% |
| Indigo | Indigo plant leaves | 1.5-2.0% |
| Saffron | "Crocus" Plant flower pistil | 7.0% |
| Annatto | Roucone tree - seed | 15.0% |
| Carotin | Carrot, red palm oil, Pumpkin Seed | < 0.5% |
| Juglone | Black Walnut hulls | 0.2% |
| Lac | Stick-lac | 0.5-0.75% |

## LIMITATIONS IN THE APPLICATION OF NATURAL DYES :

Natural dyes require mordants (a substance which combines with the dye to render it insoluble) to give substantivity. As stated earlier the commonly used mordants are alum, cream of tartar, Chrome, tin, iron, copper, tannic acid, oxalic acid and ammonia. The use of most of these substances results in metal contamination in the waste liquor resulting from the dyeing process :-

| Natural Dyes | Original Liquor | Spent Liquor | | % in Wastestream |
|---|---|---|---|---|
| Alum tartar | 340 mg/l<br>Al | Wool | 320 mg/l | 94% |
| | | Cotton | 310 mg/l | 91% |
| Potassium bichromate | 270 mg/l<br>Cr (VI) | Wool | 70 mg/l | 26% |
| | | Cotton | 220 mg/l | 82% |
| Tin (II) chloride | 395 mg/l<br>Sn | Wool | 22 mg/l | 6% |
| | | Cotton | 320 mg/l | 81% |
| Iron (II) sulphate | 201 mg/l<br>Fe | Wool | 195 mg/l | 97% |
| | | Cotton | 195 mg/l | 97% |
| Copper sulphate | 382 mg/l<br>Cu | Wool | 320 mgl/l | 84% |
| | | Cotton | 300 mg/l | 79% |

Color yield, colorfastness properties and shade vary with the mordant used so it isn't possible to simply avoid the use of those substances containing less desirable metals. Color yield of cochineal on wool is greater when premordanted with cuprous acetate than when mordanted with chromous acetate. However, colorfastness to washing is superior when mordanted with chromous acetate. The best color fastness to light is achieved when aluminium acetate is used as the mordant followed by chromous acetate and cuprous acetate in order. When Madder is mordanted to cotton with alum and lime a red shade is produced, when mordanted with tin a pink, with iron a violet and with chrome a brown

Therefore as have explained above by some examples, there are some limitations to the application of natural dyes which are :-

1. Limited ranges of shades
2. Not suitable for synthetic fibres
3. High cost of production
4. Unrealistic requirement of agriculture surfaces
5. Questionable fastness level
6. Questionable reproduciblity
7 Questionable influence on environment

The toxicity of natural dyes in their application to textiles has not bneen throughly evaluated. The fact that many FD&C (Food Drug and Cosmetic) colors are natural dyes does not mean that these same dyes are non-toxic when applied with a mordant to textiles.

It is unlikely that the present demand for dyes could be met with natural dyes. Although, the durability of some natural dyes is well established, colorfastness properties do not generally meet today's requirements nor those offered by synthetic dyes There is no natural yellow dye with acceptable colorfastness to light presently available. Dramatic improvements in application would be required to achieve the necessary substantivity levels and meet existing environemntal regulations covering waste streams; especially reduction of metals

## ALTERNATIVE SOLUTIONS :

What instead seems to be a more rational solution is that we think less is more and look at two solutions to the problem : prevention or cure. We could think of waste minimization or source reduction as an alternative to chemical treatment. The benefits of source reductions are :-

1. Decreased Waste liability
2. Decreased Waste collection costs
3. Decreased handling and treatment costs
4. Decreased loss of material and enery, i.e. more profits
5. Possibility of recycling to have recovery value of waste in addition to these benefits source reduction can come handy in preparation of eco-textiles.

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# LIST OF PROHIBITED DYESTUFFS

| Sr.No. | C.I. GENERIC NAME | C.I. No. | DIAZOCOMPONENTS |
|---|---|---|---|
| 1 | Acid Orangs 45 | 22195 | B |
| 2 | Acid Red 4 | 14710 | o-An |
| 3 | Acid Red 5 | 14905 | o-An |
| 4 | Acid Red 24 | 16140 | o-T |
| 5 | Acid Red 26 | 16150 | |
| 6 | Acid Red 73 | 27290 | p-Aab |
| 7 | Acid Red 85 | 22245 | B |
| 8 | Acid Red 114 | 23635 | T |
| 9 | Acid Red 115 | 27200 | o-A |
| 10 | Acid Red 116 | 26660 | p-Aab |
| 11 | Acid Red 128 | 24125 | D |
| 12 | Acid Red 148 | 26665 | o-A |
| 13 | Acid Red 150 | 27190 | p-Aab |
| 14 | Acid Red 158 | 20530 | o-T |
| 15 | Acid Red 167 | | T |
| 16 | Acid Red 264 | 18133 | o-An |
| 17 | Acid Red 265 | 18129 | o-T |
| 18 | Acid Red 420 | | p-Aab |
| 19 | Acid Violet 12 | 18075 | o-An |
| 20 | Acid Violet 49 | 42640 | |
| 21 | Acid Brown 415 | | o-An |
| 22 | Acid Black 29 | | B |
| 23 | Acid Black 94 | 30336 | B |
| 24 | Acid Black 131 | | o-An |
| 25 | Acid Black 132 | | o-An |
| 26 | Acid Black 209 | | T |
| 27 | Azoic Diazo Component 11 | 37085 | C |
| 28 | Azoic Diazo Component 12 | 37105 | 2 A 4 N |
| 29 | Azoic Diazo Component 48 | 37235 | D |
| 30 | Azoic Diazo Component 112 | 37225 | B |
| 31 | Azoic Diazo Component 113 | 37230 | T |
| 32 | Basic Red 111 | | p-Aab |
| 33 | Basic Red 42 | | o-An |
| 34 | Basic Brown 4 | 21010 | 2,4-T |
| 35 | Developer 14 - Oxidation Base 20 | 76035 | 2,4-T |
| 36 | Direct Yellow 1 | 22250 | B |
| 37 | Direct Yellow 24 | 22010 | B |
| 38 | Direct Yellow 48 | 23660 | T |
| 39 | Direct Orange 1 | 22370 | B |
| 40 | Direct Orange 6 | 23375 | T |
| 41 | Direct Orange 7 | 23380 | T |
| 42 | Direct Orange 8 | 22130 | B |
| 43 | Direct Orange 10 | 23370 | T |
| 44 | Direct Orange 108 | 29173 | o-T |
| 45 | Direct Red 1 | 22310 | B |
| 46 | Direct Red 2 | 23500 | T |
| 47 | Direct Red 7 | 24100 | D |
| 48 | Direct Red 10 | 22145 | B |
| 49 | Direct Red 13 | 22155 | B |
| 50 | Direct Red 17 | 22150 | B |

| Sr.No. | C.I. GENERIC NAME | C.I. No. | DIAZOCOMPONE |
|---|---|---|---|
| 51 | Direct Red 21 | 23560 | T |
| 52 | Direct Red 22 | 23565 | T |
| 53 | Direct Red 24 | 29185 | o-An |
| 54 | Direct Red 26 | 29190 | o-An |
| 55 | Direct Red 28 | 22120 | B |
| 56 | Direct Red 37 | 22240 | B |
| 57 | Direct Red 39 | 23630 | T |
| 58 | Direct Red 44 | 22500 | B |
| 59 | Direct Red 46 | 23050 | DcB |
| 60 | Direct Red 62 | 29175 | o-T |
| 61 | Direct Red 67 | 23505 | T |
| 62 | Direct Red 72 | 29200 | o-An |
| 63 | Direct Violet 1 | 22570 | B |
| 64 | Direct Violet 12 | 22550 | B |
| 65 | Direct Violet 21 | 23520 | T |
| 66 | Direct Violet 22 | 22480 | B |
| 67 | Direct Blue 1 | 24410 | D |
| 68 | Direct Blue 2 | 22590 | B |
| 69 | Direct Blue 3 | 23705 | T |
| 70 | Direct Blue 6 | 22610 | B |
| 71 | Direct Blue 8 | 24140 | D |
| 72 | Direct Blue 9 | 24155 | D |
| 73 | Direct Blue 10 | 24340 | D |
| 74 | Direct Blue 14 | 23850 | T |
| 75 | Direct Blue 15 | 24400 | D |
| 76 | Direct Blue 22 | 24280 | D |
| 77 | Direct Blue 25 | 23790 | T |
| 78 | Direct Blue 35 | 24145 | D |
| 79 | Direct Blue 53 | 23860 | |
| 80 | Direct Blue 76 | 24411 | D |
| 81 | Direct Blue 151 | 324175 | D |
| 82 | Direct Blue 160 | | D |
| 83 | Direct Blue 173 | | D |
| 84 | Direct Blue 192 | | D |
| 85 | Direct Blue 201 | | D |
| 86 | Direct Blue 215 | 24115 | D |
| 87 | Direct Blue 295 | 23820 | T |
| 88 | Direct Green 1 | 30280 | B |
| 89 | Direct Green 6 | 30295 | B |
| 90 | Direct Green 8 | 30315 | B |
| 91 | Direct Green 8.1 | | B |
| 92 | Direct Green 85 | 30387 | T |
| 93 | Direct Brown 1 | 30045 | B |
| 94 | Direct Brown 12 | 30110 | B |
| 95 | Direct Brown 2 | 22311 | B |
| 96 | Direct Brown 6 | 30140 | B |
| 97 | Direct Brown 25 | 36030 | B |
| 98 | Direct Brown 27 | 31725 | B |
| 99 | Direct Brown 31 | 35660 | B |
| 100 | Direct Brown 33 | 35520 | B |
| 101 | Direct Brown 51 | 31710 | B |
| 102 | Direct Brown 59 | 22345 | B |
| 103 | Direct Brown 79 | 30056 | B |
| 104 | Direct Brown 95 | 30145 | B |
| 105 | Direct Brown 101 | 31740 | B |

| Sr.No. | C.I. GENERIC NAME | C.I. No. | DIAZOCOMPONENTS |
|---|---|---|---|
| 106 | Director Blue 154 | 30120 | B |
| 107 | Director Blue 222 | 30368 | T |
| 108 | Direct Black 4 | 30245 | B |
| 109 | Direct Black 29 | 33580 | B |
| 110 | Direct Black 38 | 30235 | B |
| 111 | Direct Black 91 | 30400 | D |
| 112 | Direct Black 154 |  | T |
| 113 | Disperse Yellow 7 | 26090 | p-Aab |
| 114 | Disperse Yellow 23 | 26070 | p-Aab |
| 115 | Disperse Yellow 56 |  | p-Aab |
| 116 | Disperse Orange 149 |  | p-Aab |
| 117 | Disperse Red 151 | 26130 | p-Aab |
| 118 | Disperse Blue 1 | 64500 |  |

Arylamines which can be released by the listed azo-dyestuffs :

| | |
|---|---|
| O-A | o-Aminoazotoluene (III A2) |
| p-Aab | p-aminoazobenzene (III A2) |
| o-An | 2-Methoxyaniline (II A2) |
| 2-A-4-N | 2-Amino-4-nitrotolune (III A2) |
| B | Benzidine (III A1) |
| C | 4-Chlor-o-toludine (III A1) |
| D | 3,3-Dimethoxybenzidine (III A2) |
| DcB | Dichlorobenzidine (III A2) |
| N | 2-Naphthylamine (III A1) |
| o-T | o-Toluidine (III A2) |
| T | 3.3-Dimethylbenzidine (III A2) |
| 2,4-T | 4,Methyl-1,3-phenylenediamine (III A2)s |

# Programme on Energy, Environment, Resources, and Sustainability (PEERS) - 1997/98

## Final Project Report

# Sustainable development of persons wi disability in rural areas of Madhya Pradesh through community based rehabilitation

*Submitted by*
Mr Vivek Dhand

April 1998

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*Conducted by:* Tata Energy Research Institute (TERI), New Delhi

*In collaboration with:*
United Nations University, Tokyo
Institute for Energy Technology (IFE), Norway
International Institute for Sustainable Development (IISD), Canada

*Supported by:*
Norwegian Agency for Development Corporation (NORAD)
Canadian International Development Agency (CIDA)

**PROJECT REPORT ON**

# SUSTAINABLE DEVELOPMENT
# OF
# PERSONS WITH DISABILITY
# IN
# RURAL AREAS OF
# MADHYA-PRADESH
# THROUGH
# COMMUNITY BASED REHABILITATION

**VIVEK DHAND**

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# *Index*

P.No.

ction. 3

Disability, and The Act Of 1995. 4

a Pradesh-Profile. 7

ence Of Disability In Madhya Pradesh-Survey. 9

: Present status. 18

tive Factors. 19

ing Issues. 20

holders Analysis. 27

ive. 32

ure Of The Service Delivery System. 46

nment Building. 57

g Of The Volunteers / Organisers. 59

articipation. 66

mic Rehabilitation. 67

ies; Clearing of Backlog. 68

tion. 70

tion for the disabled 71

iscrimination. 74

dar of activities. 75

ial Resource Mobilisation 76

inability 78

sed Expenditure. 88

# 1. Introduction

India the second most populous country of the world, has just entered its fiftieth year of independence. Majority of the population lives in rural areas, where the incidence of poverty is high. It is among these poor masses that we find, to a great extent, problem of illiteracy, malnutrition, and prevalence of unhygienic conditions. All these are the causative factors for diseases and disability . It is here, that the prenatal, perinatal and post natal care of mother and child get lowest attention, which is the major cause of disability. "At risk" cases are not identified in time, thus giving a go by to the prevention aspect of disability. On these remote fringes of our society, subsist an enormous mass of unseen and unheard. These are the uncared, physically and mentally disabled persons, who do not need pity but proper understanding and a little support from the society to enable them to lead a life of dignity and self reliance. According to the National Sample Survey Organisation (NSSO), the prevalence of disability in India is almost 4.2 percent.

## 2. ABOUT DISABILITY, AND THE ACT OF 1995

World Health Organisation (WHO) defines "impairement" as a loss or reduction of normal functioning of any physiological functions. When such impairement results in partial or total inability to perform any bodily or mental function in the manner or within the range considered normal for a human being, it is described as a disability.

The meeting to launch the Asian and Pacific Decade of Disabled Persons 1993-2002 was held at Beijing in Dec.1992 by the Economic and Social Commission for Asia and Pacific. The meeting adopted the proclamation on the Full Participation and Equality of People with Disabilities in the Asian and Pacific Region. India is a signatory to this Proclamation. To fulfill this commitment, the Act of 1995 has been framed.

THE PERSONS WITH DISABILITIES (EQUAL OPPORTUNITIES, PROTECTION OF RIGHTS AND FULL PARTICIPATION) ACT, 1995, RECEIVED THE ASSENT OF THE PRESIDENT OF INDIA ON I$^{ST}$ JAN.1996.

The term 'disability' has been given a legal meaning for the first time in India, under the Act. Disability means-blindness; low vision; leprosy-cured; hearing impairement; locomotor disability; mental retardation and mental illness. Persons with disabilities include persons suffering from not less than forty percent of any disability as certified by a medical authority.

The persons with Disabilities (Equal opportunities, Protection of Rights & Full Participation) Act, 1995, has imposed various duties & responsibilities over Central Government as well as various State Governments. The Act is effective from 7th Feb.1996.

### Provisions of the Act

### 1. Prevention and Early Detection of Disabilities.

a) Undertake survery, investigation and research concerning cause of occurrence of disabilities.

b) Promote various methods of preventing disabilities, specially through education and awareness compaigns.

c) Screen all children atleast once in a year for the purpose of identifying "at risk " cases.

## II. Education

a) Ensure that every child with disability has access to free education in an appropriate environment till 18 years of age.

b) Promote integration of students with disabilities in normal schools.

c) Promote setting up of special schools.

d) Take steps to facilitate and promote education to all disabled persons

## III Employment

(a) To Identify posts in the establishment which can be reserved for persons with disability. Atleast 3% posts in Govt. and Govt. aided institutions be reserved for the disabled.

## IV. Affirmative action

The Government shall make schemes to provide aids & appliances to persons with disabilities. The Government and local authorities shall frame schemes for preferential allotment of land at concessional rate for house, setting business, etc. in favour of persons with disabilities.

## V. Non-Discrimination

Establishment in transport sector shall take special measures to -

a) adapt rail compartments, buses, vessels, and air-craft, in such a way as to permit easy access to disabled persons.

b) adapt toilets in these means of transport

c) Installation of auditory signals at red lights in the public roads.

d) Warning signals at appropriate places.

e) ramps in public buildings, hospitals, PHCs, and other medical care & rehabilitation centres.

VI. **Research and Manpower Development.**

The Government & local authorities shall promote and sponsor research in areas of-prevention of disability, **rehabilitation including community based rehabilitation**, assistive devices, job identification etc.

VII. **Social Security**

The Government and the local authorities shall undertake rehabilitation of all persons with disabilities. Government and local authorities shall grant financial assistance to NGOs also who are working for such rehabilitation.

**Publicizing the Act could be a tool to educate and empower people with disabilities. Getting the people to demand can happen only when they become aware of their due share.**

## 3. Madhya Pradesh- Profile

Madhya Pradesh is the largest and according to most inter state comparisons, one of the most backward states, in the country. Given the historical burden of " colonial backwardness", the scenario of human development in Madhya Pradesh is indeed grim. Whether it is education, health or livelihoods, the outcomes (such as literacy and school enrolement, fertility and access to health services, etc.) relating to quality of life and entitlements of the people are far from satisfactory. Nearly 10 percent of the absolute number of people living below the poverty line in India, reside in the state of Madhya Pradesh. Female literacy rates, infant mortality rates, considered to be important indicators of human development, continue to be far below the national average.

Madhya Pradesh accounts for 7.83 percent of the country's population and 13.48 percent of the Country's geographical area. However, it is among the poorest states in terms of per capita income as well as human development. Infact, Madhya Pradesh along with Bihar, Rajsthan and Uttar Pradesh are often called the BIMARU states an acronym that suggests that these state economies are ailing.

In 1991, the literacy rate was 43.5% (All India 52.10%), Female literacy rate was 28.40% (All India 39.40%), Average number of years of schooling for 1987-88 was 3.61 (All India 4.15). Infant Mortality Rate three years averaging 1988-90 was 116 ( All India 88). Life expectancy combined 1981-86 was 52.40 and Per Capita State Domestic product 1989 - 90 was Rs. 678/-.

Going by the above indicators, Madhya Pradesh ranked 12th in Literacy Rate (1990-91), 12th in Female Literacy Rate (1991), 13th in Average number of years of schooling (1987-88), 14th in Infant Mortality Rate (88-90), 13th in Life Expectancy (1981-86), and 15th in the Per Capita State Domestic Product 1989-90), among the first fifteen populous states of the country.

Gender ratio in Madhya Pradesh ( 1991 Census) is 931 female to 1000 males. Among the schedules tribes, it is 985, whereas for schedule castes it is 915. In the absence of known sex selective pattern of migration, it can be assumed that the sex ratio is affected by sex selective loss due to death.

Madhya Pradesh has a population of 661 lakhs (1991 census) and with an area of 4.43 lakhs sq.kms. it is the largest state of the country. The S.C. and S.T. population is 14.5% and 23.3% respectively. It has 45 districts, 45 Zila Panchayats, 459 Janpad Panchayats, 31,126 Gram Panchayats and 71,352 Revenue villages.

Rural population of Madhya Pradesh is dependent primarily on agriculture and allied activities. Land holdings are small and majority of the population lives below poverty line. Community is conservative and family bonds are very strong. In tribal areas, the houses are quite scattered with villages divided into a number of separate identifiable hamlets. Most of the tribal villages have headman, who are accepted as the leader of the community and command respect and obedience from the villagers.

## 4. Prevalence of Disability in Madhya Pradesh

Survey of disabled persons is not a part of the regular census that is conducted in our country every ten years. In the absence of proper figures and facts the magnitude of the problem has never been projected properly. Planning any kind of welfare measure for the disabled is also not feasible without correct data. Keeping this need in mind, a One-day survey was conducted all over the State of Madhya Pradesh on 28th of January 1997. Madhya-Pradesh probably is the only state in the country to have got this type of survey conducted. This was a house hold survey, on census pattern. Training teams were formed in each of the 45 districts. They were first trained through detailed letters and personal contacts. These teams consisted mostly of doctors, panchayat office bearers, NGOs working for the welfare of the disabled and, officers of the Panchayat and Social Welfare Department. In bigger districts, more than one, teams were formed. These training teams visited every Janpad head quarter and urban centers . These teams imparted one day training to the volunteers involved in the survey. Volunteers were drawn from amongst the Panchayat office bearers, literacy-mission workers, NGOs, government employees etc. On census pattern, each village / town was divided into "blocks". Each team was entrusted the survey of one block. Adequate publicity was made on 23rd of January, when Gram Sabhas were held all over the state. The actual survey took place between 7 A.M. and 7 P.M. on the 28th of January 1997 through these trained volunteers. The survey figures were then compiled Panchayatwise and Janpad / town-wise.

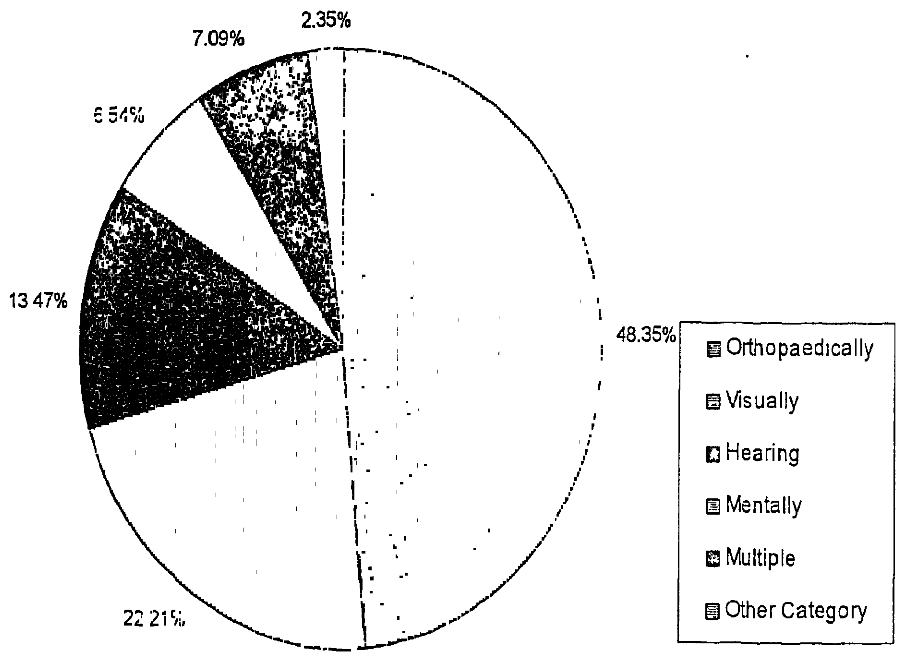
No such survey can be claimed to be exhaustive, given the social factors as they are. They lead to under reporting, specially in case of mentally disabled. However, the statistics generated by the survey is authentic basis for the formulation of the programmes and public policy initiatives for the rehabitation of the population with disabilities in the state.

## The survey reveals that :-

### (A) Prevalence of Disability in Madhya Pradesh State-wide Survey of Distabled Persons Conducted on 28th Jan.1997

(1991 cansus)

| S.No. | Category | No.of | Percentage | Percentage Population |
|---|---|---|---|---|
| 1 | Orthopaedically | 714419 | 48.35 | 1.08 |
| 2 | Visually | 328147 | 22.21 | 0.49 |
| 3 | Hearing | 199010 | 13.47 | 0.3 |
| 4 | Mentally | 96629 | 6.54 | 0.15 |
| 5 | Multiple | 104805 | 7.09 | 0.16 |
| 6 | Other Category | 34698 | 2.35 | 0.05 |
|  | Total | 1477708 | 100 | 2.23 |

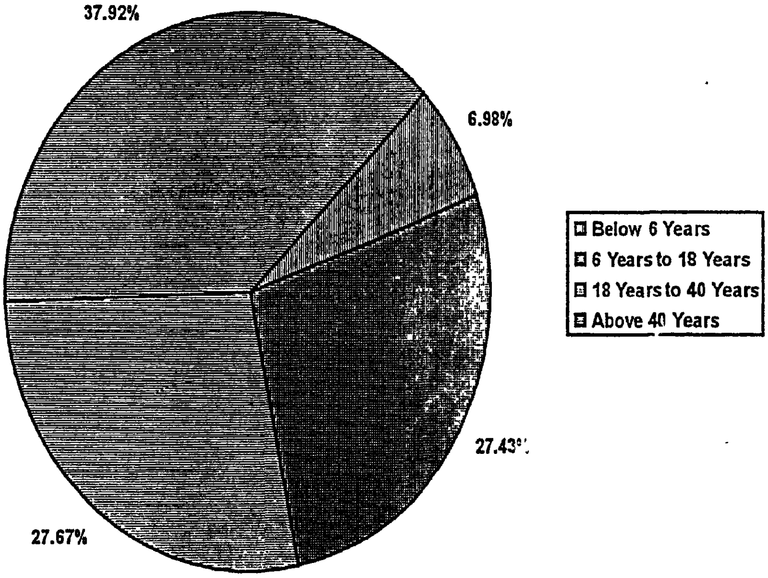


NSSO had, in 1991, envisaged 1.9% physically handicapped and 2.3% mentally disabled persons in the country.
These survey figures appear to be on the lower side
(specially for the mentally disabled)

## (B) AGE

### ALMOST ONE THIRD OF THE DISABLED ARE BELOW 18 YEARS OF AGE

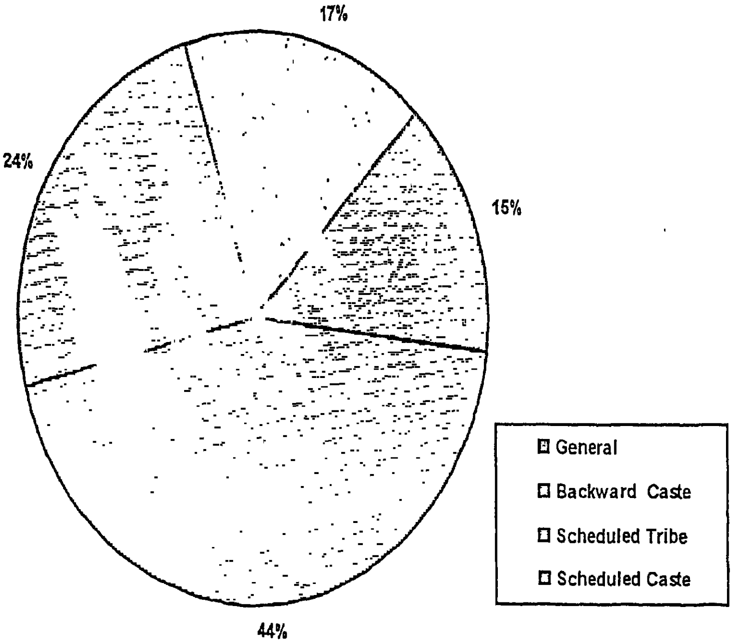
| AGE-GROUP | NUMBER | PERCENTAGE |
|---|---|---|
| Below 6 Years | 103177 | 6.98 |
| 6 Years to 18 Years | 405290 | 27.43 |
| 18 Years to 40 Years | 408925 | 27.67 |
| Above 40 Years | 560316 | 37.92 |
| **Total** | **1477708** | **100** |



## (C) CASTE :

### Caste-wise Break-up of the disabled
### (As per 1991 census)

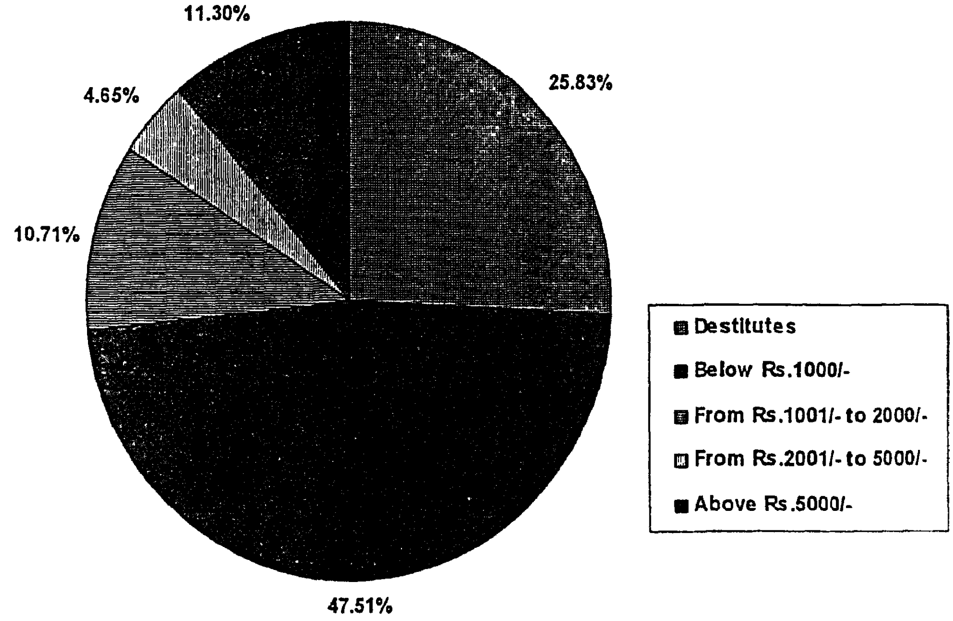
| S.No. | CASTE | NO. OF DISABLED | PERCENTAGE OF CASTE POPULATION | PERCENTAGE OF TOTAL DISABLED POPULATION |
|---|---|---|---|---|
| 1. | **General** | 217833 | 2.08% | **44%** |
| 2. | **Backward Caste** | 660371 | - | **24%** |
| 3. | **Scheduled Tribe** | 361127 | 2.34% | **17%** |
| 4. | **Scheduled Caste** | 258377 | 2.68% | **15%** |
| | **Total** | **1497708** | | |



## (D) INCOME LEVELS:

### ONE OUT OF EVERY FOUR DISABLED IS A DESTITUTE

| S.NO. | FAMILY INCOME ( PER MONTH) | NUMBER | PERCENTAGE |
|---|---|---|---|
| 1. | Destitutes | 368690 | 25.83 |
| 2. | Below Rs.1000/- | 678156 | 47.51 |
| 3. | From Rs.1001/- to 2000/- | 152934 | 10.71 |
| 4. | From Rs.2001/- to 5000/- | 66431 | 4.65 |
| 5. | Above Rs.5000/- | 161247 | 11.30 |
|  | **Total** | **1427458** | **100** |



**Incidence of disability among the poor is very high. Almost 73% of the disabled population lives below the poverty line i.e. Three out of every four disabled are living below the poverty line.**

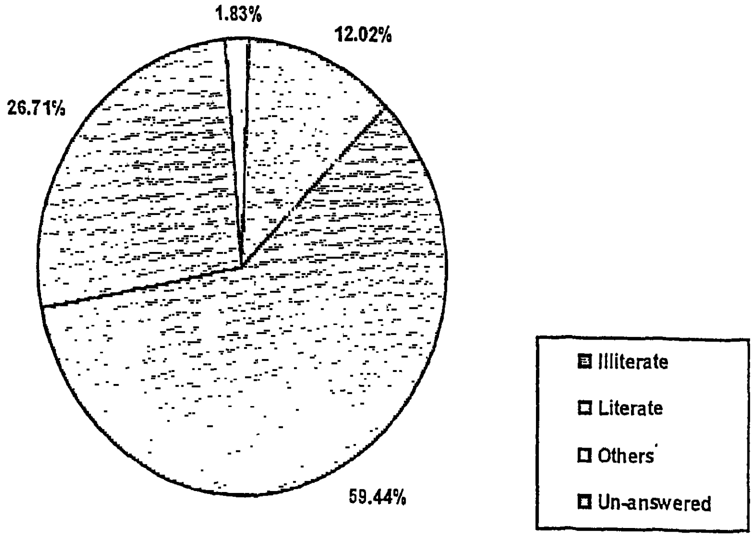
## (E) EDUCATIONAL STATUS :

### THREE OUT OF EVERY FIVE DISABLED PERSONS DID NOT HAVE ACCESS TO EDUCATION

| EDUCATIONAL STATUS | NUMBER | PERCENTAGE |
|---|---|---|
| Illiterate | 878310 | 59.44 |
| Literate | 394696 | 26.71 |
| Others | 27043 | 1.83 |
| Un-answered | 177659 | 12.02 |
| **Total** | **1477708** | **100** |

Only one in 7 within the age group 6-18 years, is in the education system system .

Of the literate - as many as 56% have had just primary eduction, about 25% could go upto the middle school level and 14% of the literate are graduates. Only 1% of the literate disabled persons are technically trained.

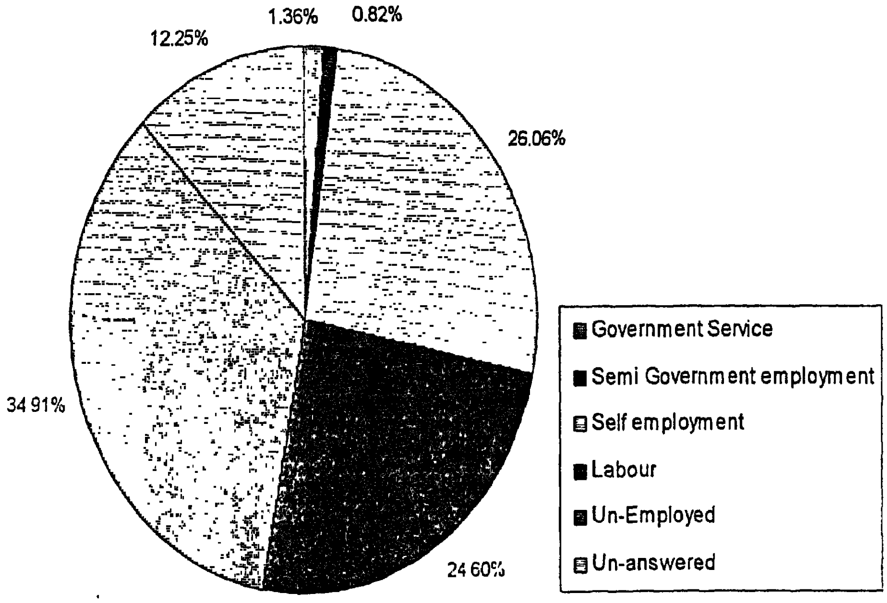


## (F) EMPLOYMENT :

### 35% OF THE DISABALED ARE UN-EMPLOYED

| S.NO. | EMPLOYMENT DESCRIPTION | NUMBER | PERCENTAGE |
|---|---|---|---|
| 1 | Government Service | 20096 | 1.36 |
| 2 | Semi Government employment | 12111 | 0.82 |
| 3 | Self employment | 385062 | 26.06 |
| 4 | Labour | 363556 | 24.60 |
| 5 | Un-Employed | 515929 | 34.91 |
| 6 | Un-answered | 180954 | 12.25 |
|  | Total | 1477708 | 100 |

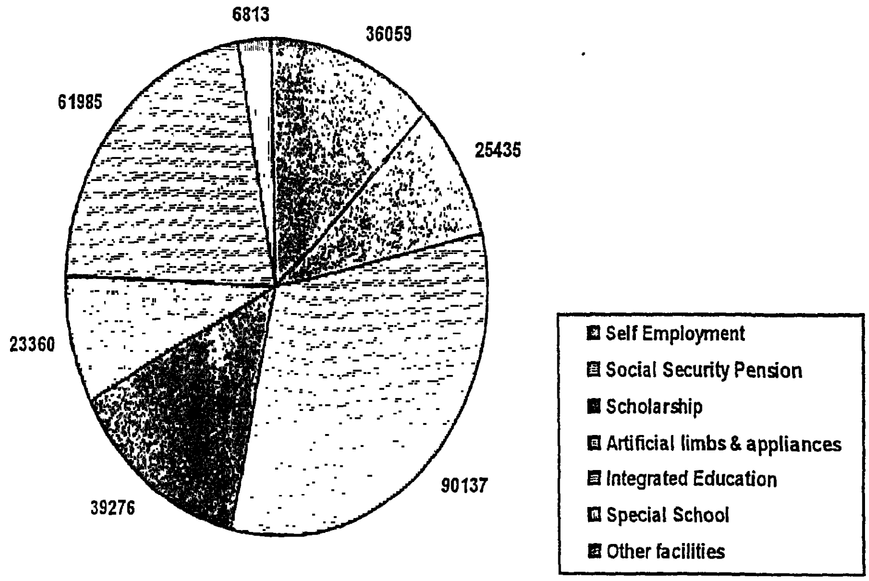
**The proportion of un-employed disabled and disabled working as labour is quite high**



## (G) REACH OF THE GOVT. :

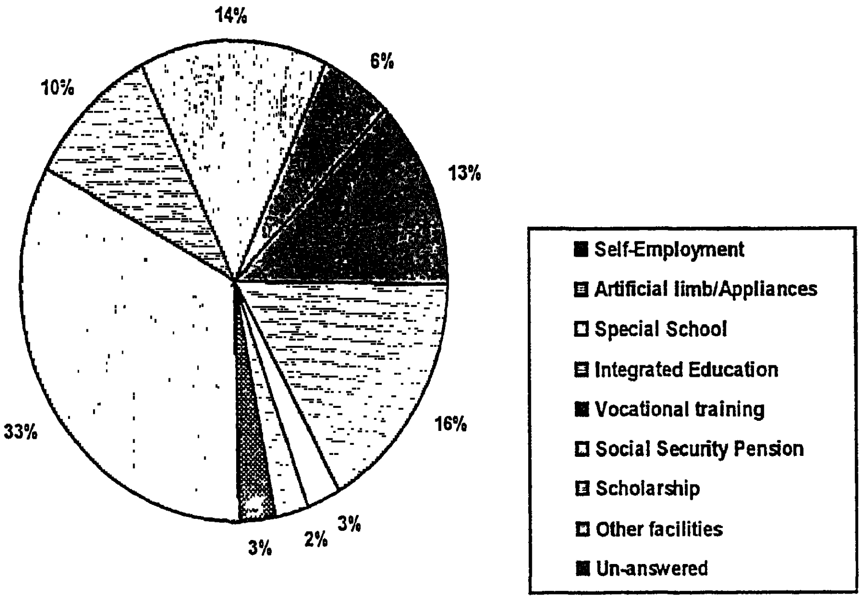
### WE HAVE BEEN ABLE TO REACH ONLY ONE OUT OF EVERY FIVE DISABLED PERSONS WITH THE BENEFITS OF GOVT. SCHEMES

| S.NO. | DESCRIPTION | NUMBER | PERCENTAGE |
|---|---|---|---|
| 1. | Self Employment | 25435 | 1.72 |
| 2. | Social Security Pension | 90137 | 6.09 |
| 3. | Scholarship | 39276 | 2.66 |
| 4. | Artificial limbs & appliances | 23360 | 1.59 |
| 5. | Integrated Education | 61985 | 4.19 |
| 6. | Special School | 6813 | 0.46 |
| 7. | Other facilities | 36059 | 2.44 |
| | **Total** | **283065** | **19.25** |



(H) Expectations :- The most significant aspect of our survey was that we asked the respondents what their expectations were. The responses are revealing.

| S.NO. | DESCRIPTION | NUMBER | PERCENTAGE |
|---|---|---|---|
| 1 | Self-Employment | 190352 | 12.88 |
| 2 | Artificial limb/Appliances | 243187 | 16.46 |
| 3 | Special School | 37693 | 2.55 |
| 4 | Integrated Education | 36417 | 2.46 |
| 4 | Vocational training | 43695 | 2.96 |
| 6 | Social Security Pension | 487193 | 32.97 |
| 7 | Scholarship | 149471 | 10.12 |
| 8 | Other facilities | 206711 | 13.99 |
| 9 | Un-answered | 82989 | 5.62 |
|  | **Total** | **1477708** | **100** |



One in seven person with disabilities would rather become self dependent then being dependent on Government for employment or social security.

## 5- NGOs working in the field of disabled persons in M.P.

(YEAR 96-97)

| S.NO. | DESCRIPTION (NGOs working for) | INSTITUTIONS | BENEFICIARIES |
|---|---|---|---|
| 1 | Orthopaedically disabled | 16 | 1141 |
| 2 | Mentally retarded | 11 | 721 |
| 3 | Visually impaired | 9 | 855 |
| 4 | Hearing impaired | 8 | 674 |
| 5 | Vocational training centres for disabled | 11 | 622 |
| 6 | Leprosy curead persons | 7 | 220 |
| 7 | Institutions working for treatment, distribution of aids and appliances for various categories of disabled | 33 | 2375 |
|  | **Total** | **95** | **6608** |

**( Govt. of India Welfare Ministry has sanctioned assistive grant of Rs.72.00 lakhs for the year 1996 -97**

## 6. Causative Factors :-

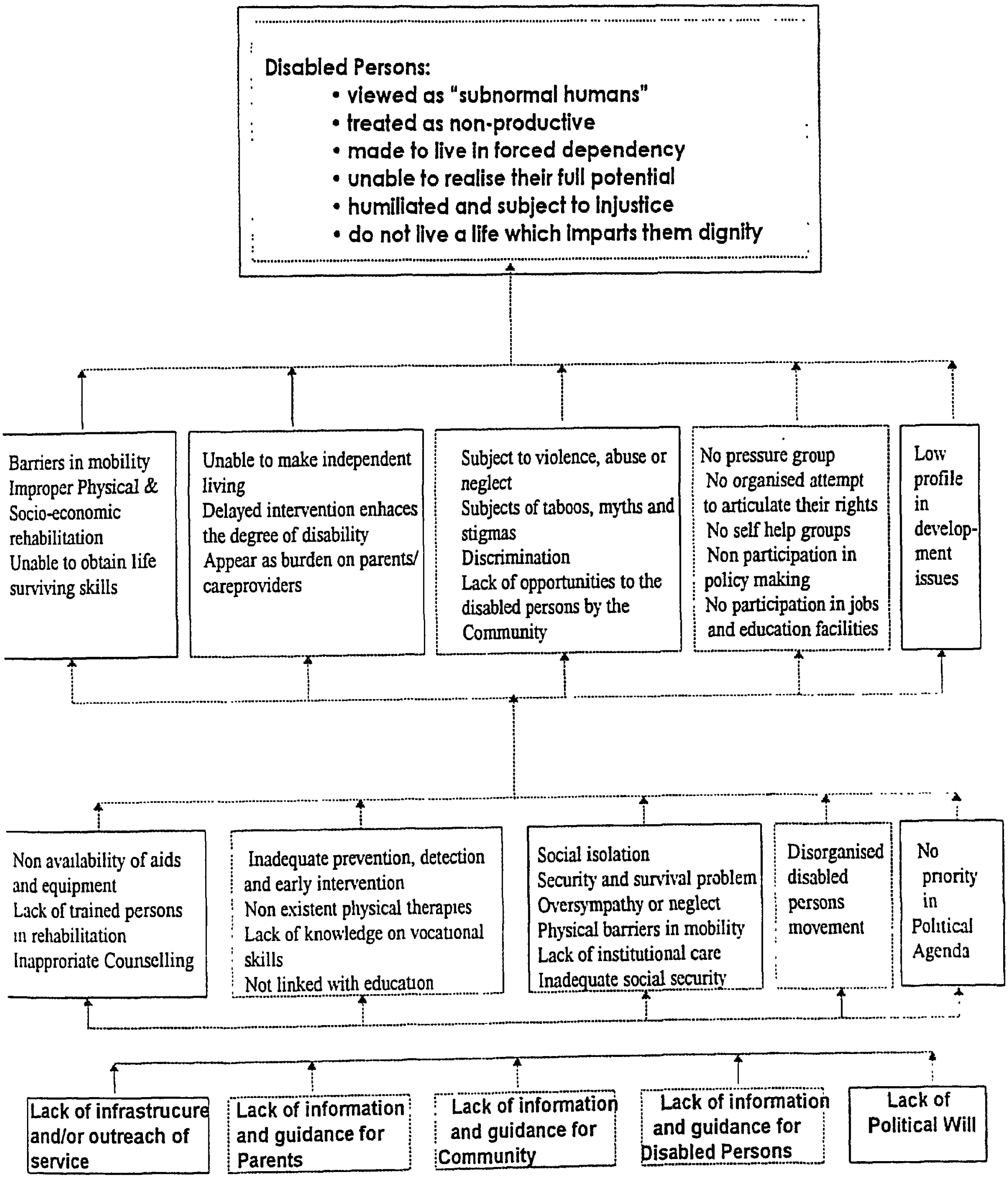
The problem requires a wholistic approach; which so far has not been adopted. It also varies from region to the region within the state itself. Certian regions in the state have higher incidence of leprosy, while iodine-deficiency is more prevalent in another. Consumption of Khesari Dal has lead to lathryism in some parts of the state. Lack of social awareness has proved to be the biggest hurdle in adoption of a humanitarian approach to this problem. Family based rehabilitation of the disabled has lacked because the family members do not have proper knowledge of the issue. In the absence of this awareness, there never was a political will to solve this problem. Proper environment or environment bulilding has also not taken place in our society. Many of the disabled persons are disabled by birth, but the incidence of disability acquired later due to the following reasons is also quite high :-

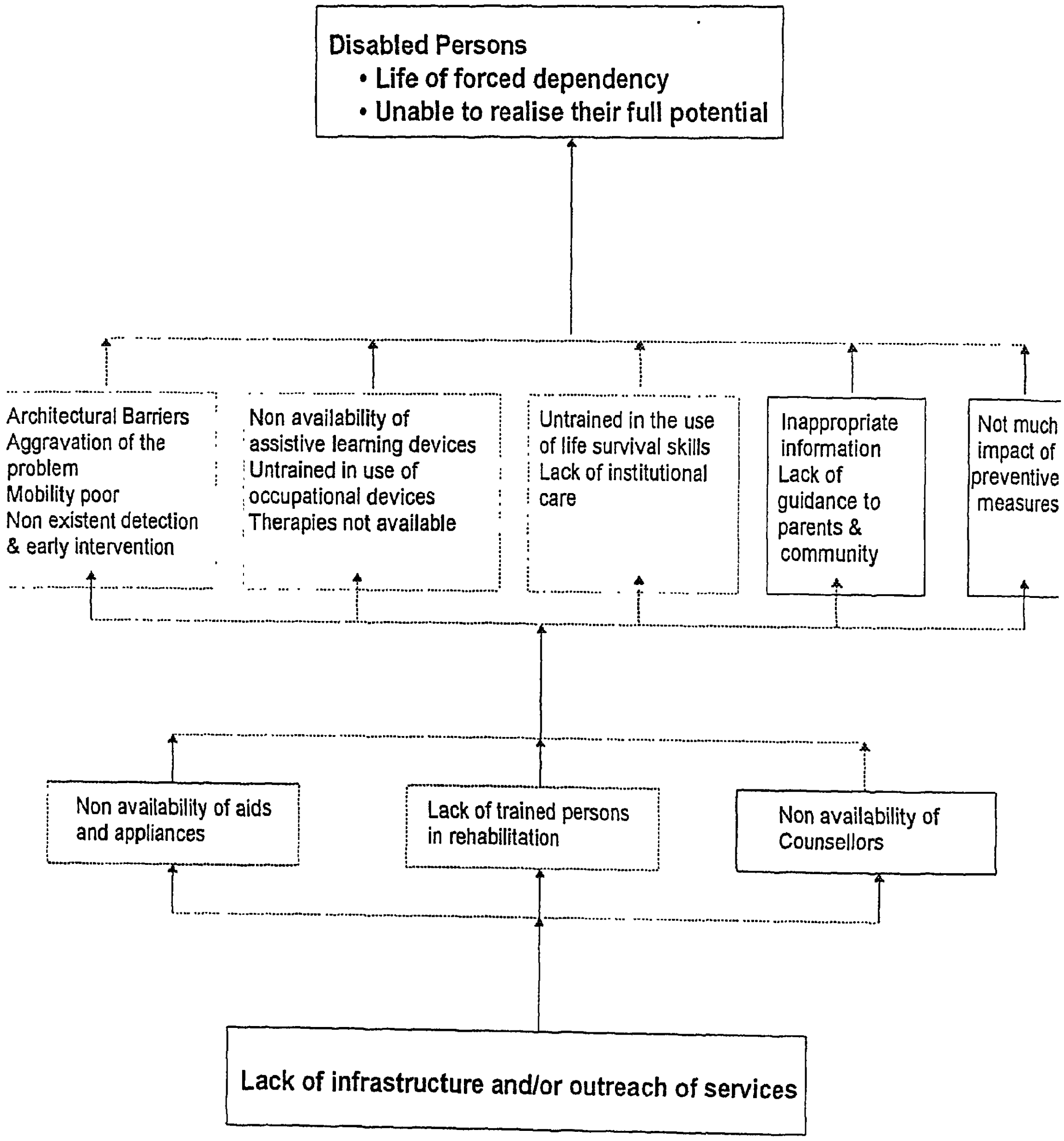
- Polio disease .
- Lack of vitamin A causing blindness.
- Insanitary conditions leading to leprosy.
- Road/Rail accident leading to amputation of limbs.
- Disability in any part of the body due to other accidents at home and outside during work.
- Blindness due to Glaucoma, cataract, etc.
- Infirmity due to mal-nutrition.
- Accidents during agricultural operations eg. While working with chef-cutters.
- Accident in factory, Mine.

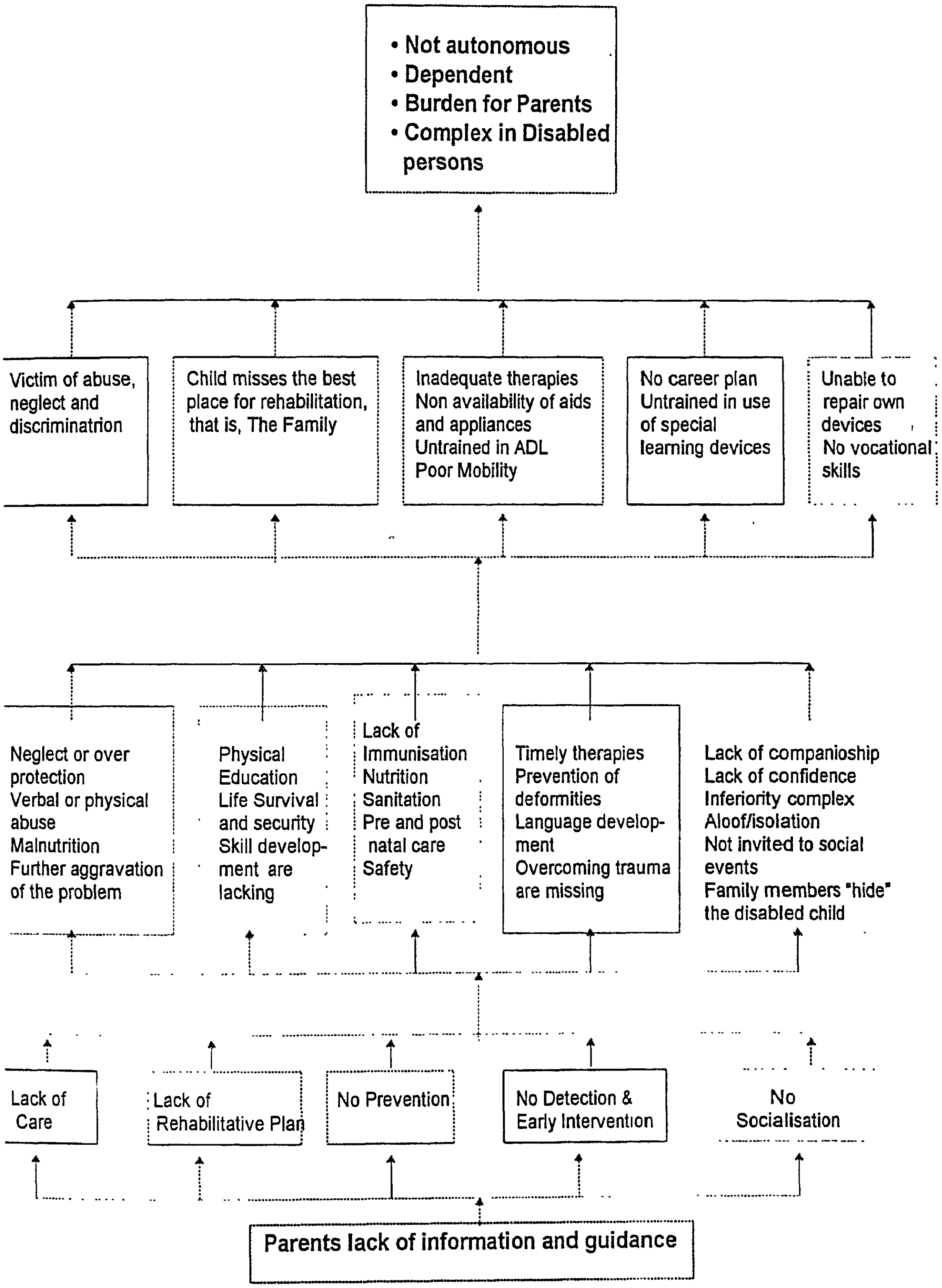
## 7. Emerging Issues:

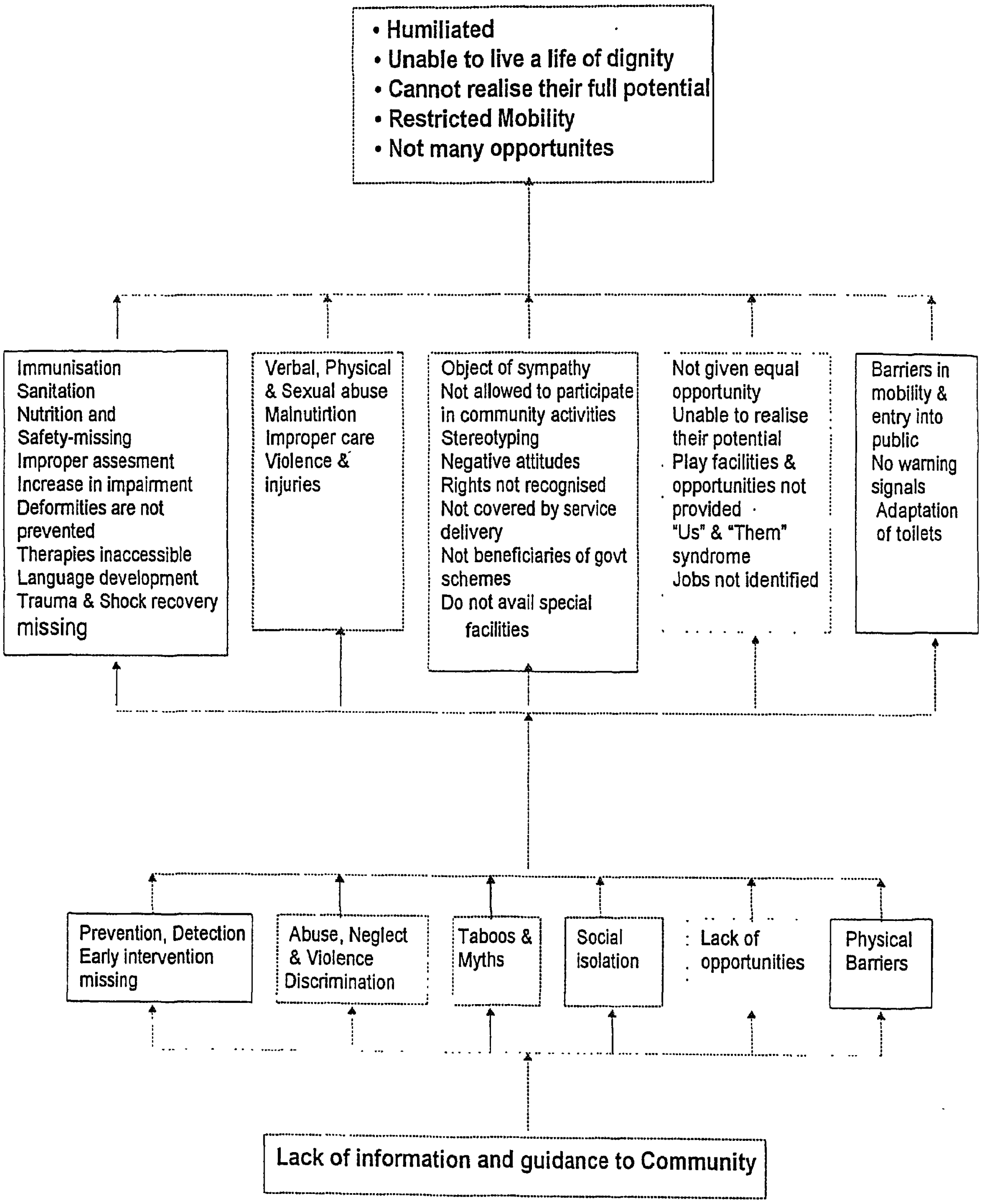
**The survey results point out :**

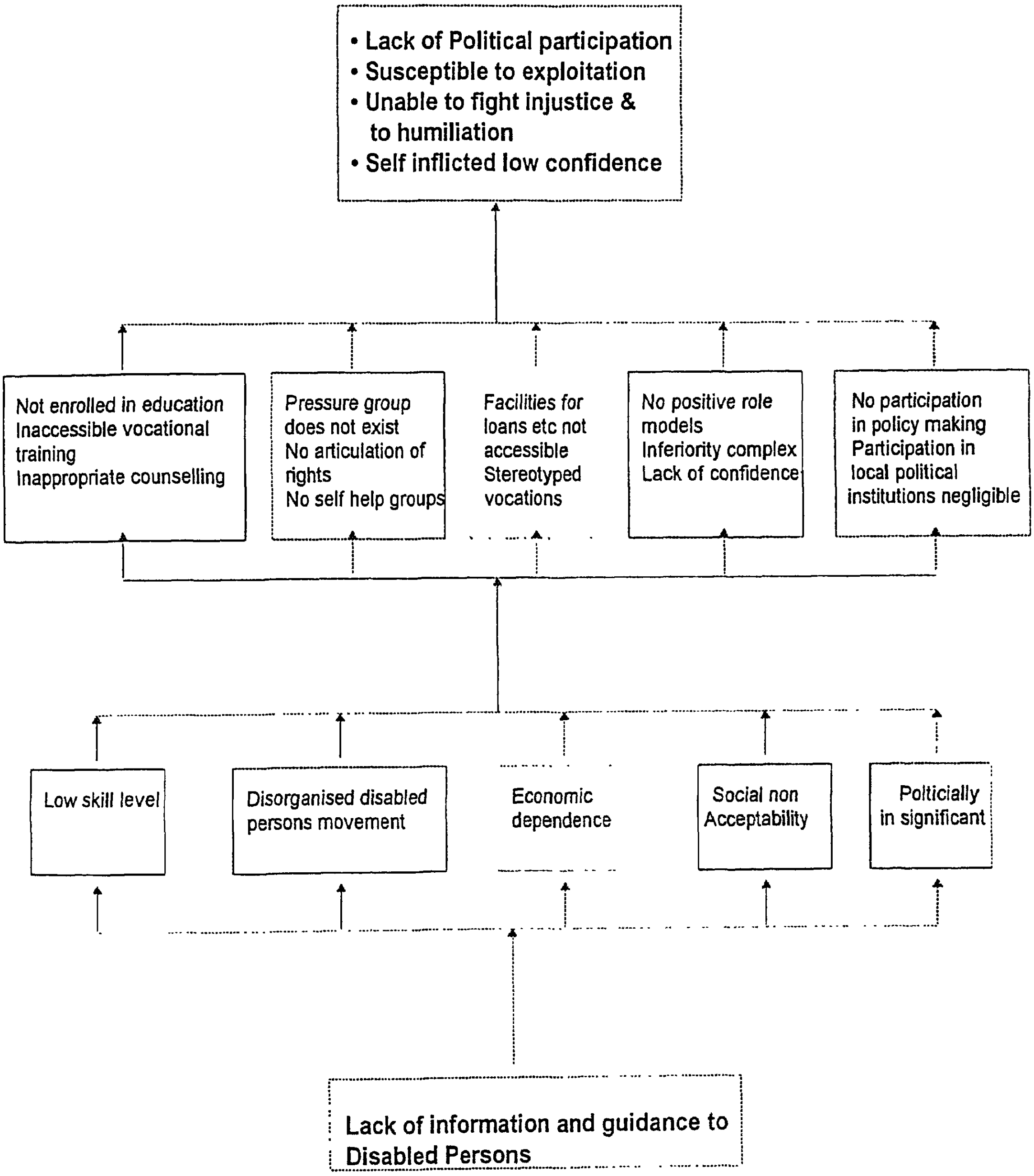
- the need for improving delivery of services under the existing welfare programmes.
- ensuring greater participation in programmes of poverty alleviation and self employment.
- Improving skill levels for the disabled is an emergent need.
- stepping up of efforts in integrated education, along with increase in special education.
- ensuring effective flow of information to people with disabilities about their rights, and to organise them for a greater say in matters affecting them.
- convergence of services, schemes and programmes for the prevention of disabilities.
- Mobilization and better pooling of resources available for rehabilitation and welfare.
- sensitizing the community towards the rights of people with disability and mobilizing community participation.
- ensuring better out-reach for the physcial and health related rehabilitation schemes and effective follow-up and after care.
- creating environment for greater participation by NGO's.

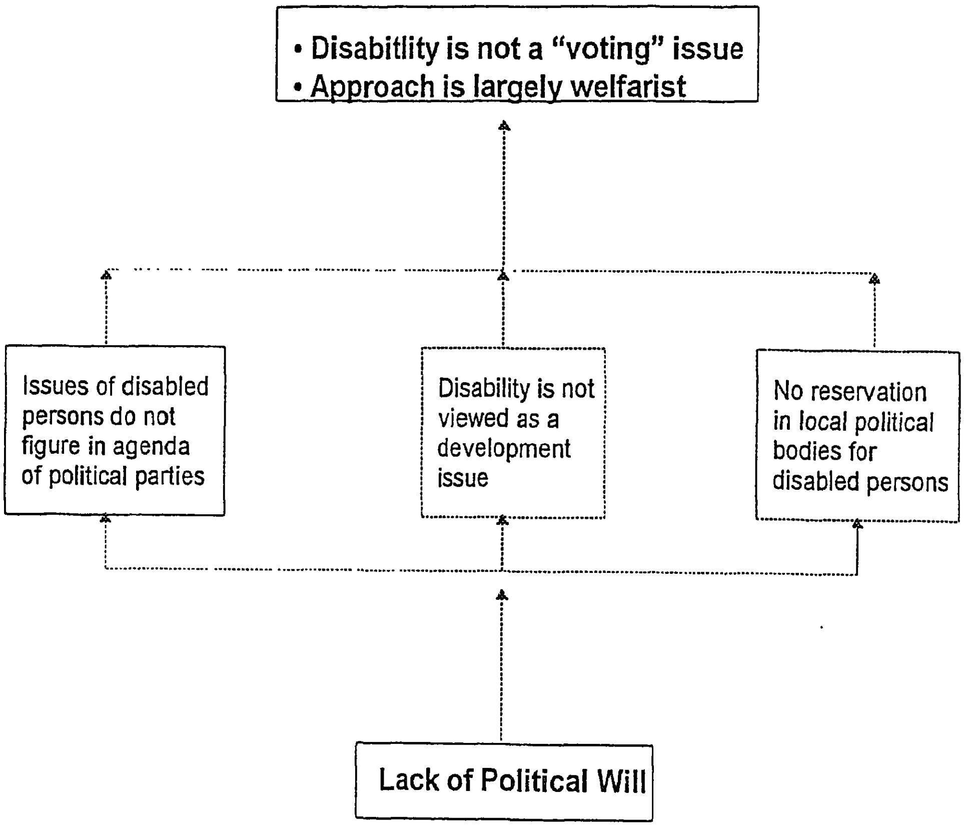

Disabled Persons:
• viewed as "subnormal humans"
• treated as non-productive
• made to live in forced dependency
• unable to realise their full potential
• humiliated and subject to injustice
• do not live a life which imparts them dignity
Barriers in mobility
Improper Physical & Socio-economic rehabilitation
Unable to obtain life surviving skills
Unable to make independent living
Delayed intervention enhaces the degree of disability
Appear as burden on parents/ careproviders
Subject to violence, abuse or neglect
Subjects of taboos, myths and stigmas
Discrimination
Lack of opportunities to the disabled persons by the Community
No pressure group
No organised attempt to articulate their rights
No self help groups
Non participation in policy making
No participation in jobs and education facilities
Low profile in development issues
Non availability of aids and equipment
Lack of trained persons in rehabilitation
Inapproriate Counselling
Inadequate prevention, detection and early intervention
Non existent physical therapies
Lack of knowledge on vocational skills
Not linked with education
Social isolation
Security and survival problem
Oversympathy or neglect
Physical barriers in mobility
Lack of institutional care
Inadequate social security
Disorganised disabled persons movement
No priority in Political Agenda
Lack of infrastrucure and/or outreach of service
Lack of information and guidance for Parents
Lack of information and guidance for Community
Lack of information and guidance for Disabled Persons
Lack of Political Will


Disabled Persons
• Life of forced dependency
• Unable to realise their full potential
Architectural Barriers
Aggravation of the problem
Mobility poor
Non existent detection & early intervention
Non availability of assistive learning devices
Untrained in use of occupational devices
Therapies not available
Untrained in the use of life survival skills
Lack of institutional care
Inappropriate information
Lack of guidance to parents & community
Not much impact of preventive measures
Non availability of aids and appliances
Lack of trained persons in rehabilitation
Non availability of Counsellors
Lack of infrastructure and/or outreach of services


• Not autonomous
• Dependent
• Burden for Parents
• Complex in Disabled persons
Victim of abuse, neglect and discriminatrion
Child misses the best place for rehabilitation, that is, The Family
Inadequate therapies Non availability of aids and appliances Untrained in ADL Poor Mobility
No career plan Untrained in use of special learning devices
Unable to repair own devices No vocational skills
Neglect or over protection Verbal or physical abuse Malnutrition Further aggravation of the problem
Physical Education Life Survival and security Skill development are lacking
Lack of Immunisation Nutrition Sanitation Pre and post natal care Safety
Timely therapies Prevention of deformities Language development Overcoming trauma are missing
Lack of companioship Lack of confidence Inferiority complex Aloof/isolation Not invited to social events Family members "hide" the disabled child
Lack of Care
Lack of Rehabilitative Plan
No Prevention
No Detection & Early Intervention
No Socialisation
Parents lack of information and guidance


• Humiliated
• Unable to live a life of dignity
• Cannot realise their full potential
• Restricted Mobility
• Not many opportunites
Immunisation
Sanitation
Nutrition and
Safety-missing
Improper assesment
Increase in impairment
Deformities are not
prevented
Therapies inaccessible
Language development
Trauma & Shock recovery
missing
Verbal, Physical
& Sexual abuse
Malnutirtion
Improper care
Violence &
injuries
Object of sympathy
Not allowed to participate
in community activities
Stereotyping
Negative attitudes
Rights not recognised
Not covered by service
delivery
Not beneficiaries of govt
schemes
Do not avail special
facilities
Not given equal
opportunity
Unable to realise
their potential
Play facilities &
opportunities not
provided
"Us" & "Them"
syndrome
Jobs not identified
Barriers in
mobility &
entry into
public
No warning
signals
Adaptation
of toilets
Prevention, Detection
Early intervention
missing
Abuse, Neglect
& Violence
Discrimination
Taboos &
Myths
Social
isolation
Lack of
opportunities
Physical
Barriers
Lack of information and guidance to Community


• Lack of Political participation
• Susceptible to exploitation
• Unable to fight injustice & to humiliation
• Self inflicted low confidence
Not enrolled in education
Inaccessible vocational training
Inappropriate counselling
Pressure group does not exist
No articulation of rights
No self help groups
Facilities for loans etc not accessible
Stereotyped vocations
No positive role models
Inferiority complex
Lack of confidence
No participation in policy making
Participation in local political institutions negligible
Low skill level
Disorganised disabled persons movement
Economic dependence
Social non Acceptability
Polticially in significant
Lack of information and guidance to Disabled Persons


• Disabitlity is not a "voting" issue
• Approach is largely welfarist
Issues of disabled persons do not figure in agenda of political parties
Disability is not viewed as a development issue
No reservation in local political bodies for disabled persons
Lack of Political Will

## 8- STAKEHOLDERS ANAYSIS

| Stakeholders | Identification | Characteristics | Relation to the proble |
|---|---|---|---|
| Impaired Persons | Persons with impairment-<br>• visually<br>• hearing<br>• locomotor<br>• orthopaedic<br>• mental impairment | ⇒ lack of information<br>⇒ lack of guidance<br>⇒ lack of access to facilities<br>⇒ socially isolated<br>⇒ economically low productivity<br>⇒ life of dependency<br>⇒ not organised in to self help groups<br>⇒ unable to realise their potential<br>⇒ subject to abuse, violence &/or neglect | ♦ Can be rehabilitated socially and economically<br>♦ Capable of being integrated with the society<br>♦ Can take control over decisions which affect their lives<br>♦ Can live a life of dignity |
| | | | |
| Family of the Impaired person | Family of persons who have impairment including extended family and guardians: | ⇒ inability to detect impairment at an early age<br>⇒ lack of information & guidance<br>⇒ lack of access to make facilities available to the impaired persons<br>⇒ subject to negative &/or indifferent attitude of community<br>⇒ propogators of abuse, neglect or overprotection<br>⇒ not trained in undertaking social & economic rehabilitation<br>⇒ cannot take therapautic meaures on their own<br>⇒ in most cases responsible for the occurance of disability in the child, ie. can in the child. i.e can take preventive measures<br>⇒ most of the time, cannot afford the cost of rehabilitation | ♦ Create an enabling environment for the disabled persons<br>♦ The "best" persons to undertake rehabilitation<br>♦ Group which can und ertake early detection and intervention, if trained<br>♦ Can build confidence of disabled persons and guide and motivate them towards a productive life<br>♦ An important support group to the disabled persons<br>♦ Can increase the afford ability and accessibility of services for the disabled persons |

| | | | |
|---|---|---|---|
| **Community (Opinion Leaders)** | Influential persons in the community:<br>• Vilage headman<br>• Priest<br>• Teacher<br>• Retired government servants<br>• Youth clubs<br>• Mahila Mandals<br>• Money lenders<br>• Big landlords | ⇒ lack of awareness on the difference between impairment & disability<br>⇒ propogators of myths on impairment & disability<br>⇒ lack of information on early detection of impairment<br>⇒ lack of information on reasons for disability and their preventive measures<br>⇒ Knowingly or unknowingly can inflict abuse, violence on disabled persons<br>⇒ reactions range from neglect to oversympathy and over protection | Create a positive and facilitative environment for the rehabilitation of disabled persons<br>Group which can actualise preventive steps and ensure their pursuance<br>Assist the family in undertaking rehabilitative measures<br>Create social and political space for disabled persons to enable them to articulate their needs and rights<br>Group which can generate funds and other resources to enable disabled persons and their family members to access services<br>Group which can undertake self initiated steps to create a barrier free environment for the disabled persons and integrate them in to mainstream society<br>Can work towards minimising dis-abling factors in the community |
| **Community (Members of formal institutions)** | Members of Panchayat:<br>• Gram Panchayat<br>• Janpad Panchayat<br>• Zilla Panchayat<br>• Local MLA<br>• Local MP | ⇒ lack of orientation & sensitisation on problems of disabled persons<br>⇒ lack of information on government schemes for disabled persons<br>⇒ disability is not a political priority<br>⇒ disability is not viewed as a developmental issue | ♦ Can bring government schemes and services to the disabled persons in their area<br>♦ Can give political importance to problems and issues of disabled persons<br>♦ Can negotiate with government institutions to ensure outreach of services<br>♦ Can create a barrier free and a facilitative environment for integration of disabled persons<br>♦ Can influence fund allocation for the benefit of disabled persons |

| | | | |
|---|---|---|---|
| Government at the Village and Block level | Departments which are concerned with the welfare and development of disabled persons:<br>• Anganwadi worker<br>• School teacher<br>• ANM/Dai/Nurse<br>• Primary Health Centre<br>• Block Education Officer<br>• Project Officer Mahila and Bal Vikas<br>• Rural Engineering Service<br>• Panchayat and Social Welfare officer<br>• Project Officer Rural Development | ⇒ lack of orientation and sensitisation on problems of disabled persons<br>⇒ predominant approach is welfarist & not developmental<br>⇒ disabled persons do not figure as a priority target group for developmental intervention<br>⇒ flow of benefits from developmental schemes do not cater to disabled persons | • Can generate administrative momentum for the development of disabled persons and sustain it over a period of time<br>• Can become the trainers and service and information providers to the community; the family; and the disabled persons<br>• Can allocate adequate funds for carrying out rehabilitation and ensure their timely availability<br>• Can guide the members of formal institutions of the community in developing initiatives for the disabled persons<br>• Make adequate provisions for ensuring effective preventive steps<br>• Can make men, material and other resources available for rehabilitation like aids and equipments, trainings etc |
| Government at the district level | Officials from:<br>• Social Welfare<br>• Education<br>• Health<br>• Women and Child<br>• Rural Development<br>• Employment or Labour<br>• Publicity<br>• Rural engineering<br>• Vocational education departments | ⇒ lack of sensitivity and orientation on the problems of disabled persons<br>⇒ do not have a distinct rehabilitation plan for the disabled persons<br>⇒ not trained to guide the block and village level officials towards the rehabilitation of disabled persons<br>⇒ problems of disabled persons is not an administrative or a developmental priority | ♦ Can coordinate their departmental effort to focus on the problems of disabled persons<br>♦ Can become master trainers for block and village level functionaries on problems of disbaility<br>♦ Can create infrastrucutre for increasing accessibility of services<br>♦ Can promote voluntary effort in the district for providing rehabilitative and capacity building services to the disabled persons<br>♦ Can promote self help groups of disabled persons and create administrative space for advocacy by disabled persons |

| | | | |
|---|---|---|---|
| **Government at the state level** | Departments of :<br>• Social Welfare<br>• Education<br>• Health<br>• Women and Child<br>• Rural Development<br>• Employment or Labour<br>• Publicity<br>• Rural engineering<br>• Vocational education<br>• Finance<br>• Public works<br>• Housing &<br>• environment | ⇒ lack of orientation and sensitisation on problems of disabled persons<br>⇒ predominant approach is welfarist & not developmental<br>⇒ disabled persons do not figure as a priority target group for developmental intervention<br>⇒ flow of benefits from developmental schemes do not cater to disabled persons<br>⇒ do not have a state rehabilitation plan for the disabled persons<br>⇒ problems of disabled persons is not an administrative or a developmental priority<br>⇒ lack of a common understanding on the policy for rehabilitation of disabled persons | ♦ Can arrange for funds for the establishment of infrastructure and extension of service<br>♦ Can arrange for outside expert help for therapautic and rehabilitative measures<br>♦ Can state disabled persons rehabilitative policy and arrange for funds for its implementation<br>♦ Can create a facilitative administrative environment where rehabilitation of disabled persons can take place<br>♦ Ensure the implementation of Disabled Persons Act 1995 |
| Service providers including technical experts | • Suppliers of aid and equipment<br>• Technicians for adopting the aid and equipment for the disabled person<br>• Trained teachers for teaching disabled persons<br>• Expert services in health including doctors<br>• Trained Instructors and Therapists<br>• Counsellors | ⇒ Most of the trained persons and experts are institutional based. hence restricted outreach<br>⇒ High cost of rehabilitation as technical gadgets and aids and equipments are not made of local material<br>⇒ Lack of trained technicians for repair and maintainance of aid and equipment<br>⇒ Lack of trained teachers and instructors<br>⇒ Limited outreach of therapists and counsellors | ♦ Main group to provide technical assistance for the rehabilitation of the disabled persons<br>♦ Ability to train disabled persons and their family members in rehabilitation<br>♦ Train, inform and guide the community in preventive and rehabilitative measures<br>♦ The group to which the accessibility of the disabled person and his/her family has to be ensured |

| | | | |
|---|---|---|---|
| **NGOs working in the field of disability** | • NGOs working to provide aid and equipment to disabled persons<br>• NGOs working for the community based rehabilitation of the disabled persons<br>• NGOs with institutional based rehabilitation<br>• NGOs working to train the persons who will work with disabled persons<br>• NGOs to make, repair and maintain the aids and equipment of the disabled persons | ⇒ Limited outreach of NGOs<br>⇒ NGOs not organised, they are working parallely<br>⇒ No NGO in the field of research and development for the disabled persons<br>⇒ Most NGOs working towards institutional based rehabilitation<br>⇒ Lack of NGOs in many districts and areas | ♦ Can be innovative in their working<br>♦ Have the capacity to work with the community and establish a community based rehabilitative model<br>♦ Can raise funds for providing services to the disabled persons<br>♦ Can become the extended arms of government in fulfilling the needs of disabled persons and also enabling their rights<br>♦ Can break new grounds in development of aids and equipment and various trainings<br>♦ Can work towards building positive attitudes in disabled person, their family and community |
| **Self help groups of disabled persons** | • Associations of disable<br>• Federation of associatio persons | ⇒ Virtually non existent<br>⇒ The need for forming such a group does not exist<br>⇒ Most of the associations do not have exclusive member ship of the disabled eprsons<br>⇒ Unable to articulate and publicise their problems, needs and aspirations<br>⇒ Unable to influence | ♦ Can work in the self interest and make the interventions relevant and suatainable<br>♦ Can become the pressure group of the disabled persons themselves and lobby for their rights<br>♦ Can react to societal misgivings on disability and generate positive role models<br>♦ The organised group which can provide help to each other and act as resources for other disabled persons<br>♦ Can generate funds for helping each other |

## 9. OBJECTIVE :

Rehabilitation of the disabled would mean reducing the adverse effect of the impairment for an individual and enabling him/ her to achieve self reliance in the real sense . This would mean social integration and a life comparable to the normal persons in the vicinity. The right of the disabled to lead a life productive and useful to the society, just as anybody else is understood and recognised . Normally, the society, out of ignorance, responses to the disabled with prejudice. This places social and economic barrier to the disabled in leading a free and fulfilled life with full potential. Most disabled people therefore, for no fault of theirs, are forced to experience humiliation, injustice and neglect in all walks of their life.

The basic needs of the disabled people are the same as those of others. However because of their circumstances, they are not able to take advantage of the public services provided to the people by the government, or any other delivery system. More so, they are not able to take advantage of even those schemes which have been structured solely for their benefit.

Education is one of the biggest casualities. The percentage of disabled persons having access to education is very low . It is required to make collective effort for it. Integrated Education for the disabled, appears to be the only solution. Only in cases of severely disabled, schooling in special school should be resorted to. Special schools for each kind of disability would have to be opened. For vocational training, trades suitable for each kind of disability would have to be identified. Integrated vocational training (like Integrated Education) would have to be thought of, and implemented. This is possible through the Rural ITIs, Mini ITIs, ITIs, and polytechnic colleges spread all over the state.

The act of 1995 envisages 3% reservation in government jobs and also in self employment and poverty alleviation schemes. Enough awareness has to be created in the community so that the Gram sabha identifies and selects as many eligible disabled persons under these schemes, as is possible.

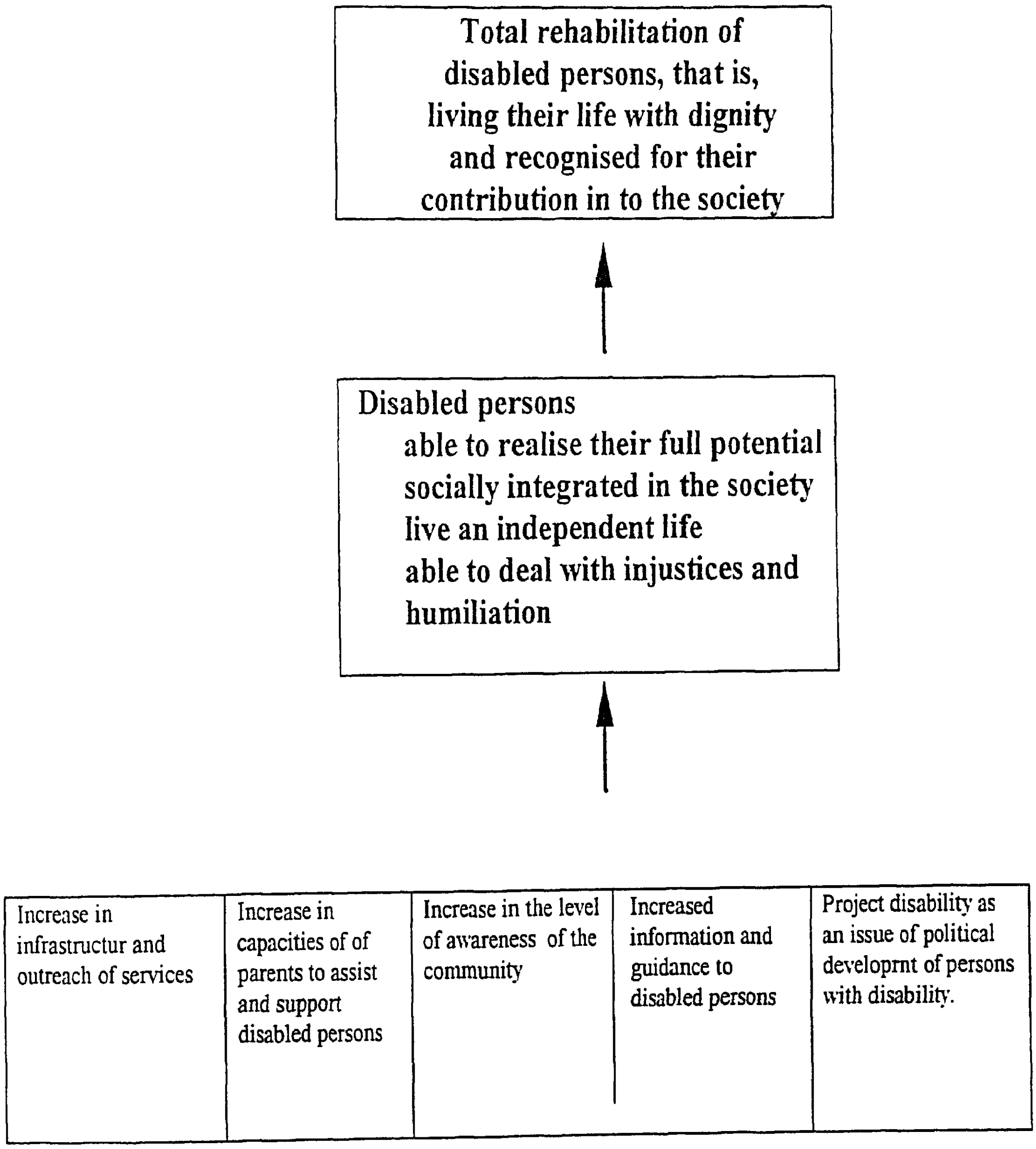
At least 50% of the disabilities are preventable. Poverty alleviation measures, if properly carried out can bring about sizeable reduction in the incidence and prevalence of diseases. Prevention of diseases through good quality water supply, improved sanitation, universal immunization and other promotive and preventive measures can reduce disabilities. Improved nutrition with a balance diet, equity, education and prevention of accidents decrease disabilities. Road, domestic and other accidents are more common among the poor and in poor communities and countries. Vitamin "A" deficiency is the most important cause of blindness in children.

Awareness is very necessary for the prevention of disabilities. Success of Pulse Polio Programme in the last two years is a very good beginning. After the onset of this drive the no. of cases reported has declined sharply. Similarly the "Rajiv Gandhi Iodine Deficiency Prevention Mission" has been successfully implemented in M.P. There is a sharp decline in the birth of children with disabilities like mental retardation / hearing impairment in the last 2 years. As Leprosy Eradication Programme is gaining grounds and the modified multidrug therapy is showing its results, community is attaching lesser stigma to this disease and cases are now being detected and treated at early stages. Reduction and loss of fear and stigma attached with leprosy is leading to early detection and complete cure of leprosy cases. The community would have to be made aware, so that such diseases are prevented long enough till they are totally eradicated. Gram sabhas / Panchayats are the right forum for this. Prenatal, perinatal and post natal care of mother and the child will help in preventing many of the diseases which cause disability. Adequate awareness will also help in identification of "at risk" cases and timely steps in prevention of disability, for eg; vitamin- A doses to check blindness; speech therapy in early stages of a totally hearing impaired child for speech development etc.

Today, with our concern for human dignity and restoration of good social order, we dream of placing the issue of "equal opportunity" back to where the soul of issue of disability belongs, namely, the family and community, partly reversing the paradigm of isolated and institutionalized services.

In a country like India, with continuing extended and joint family networks in rural areas, utilization of families for rehabilitation is feasible. Self-help group of families of people with disabilities in the community can facilitate information sharing and mutual support to meet day to day needs and to initiate other activities. A related issue is the need to promote consumer groups of people with disabilities, so that they take charge of their own lives instead of being passive recipients of welfare or charity.

Awareness, and participation of the community only, can ensure that 4.87 lac disabled people get their due social security pension, 1.59 lac eligible disabled students get their scholarship, 1.90 lac disabled persons get help under self employment and poverty alleviation programmes, and they all get education along with vocational training. **Community Based Rehabilitation (CBR) is the only solution to these problems.**

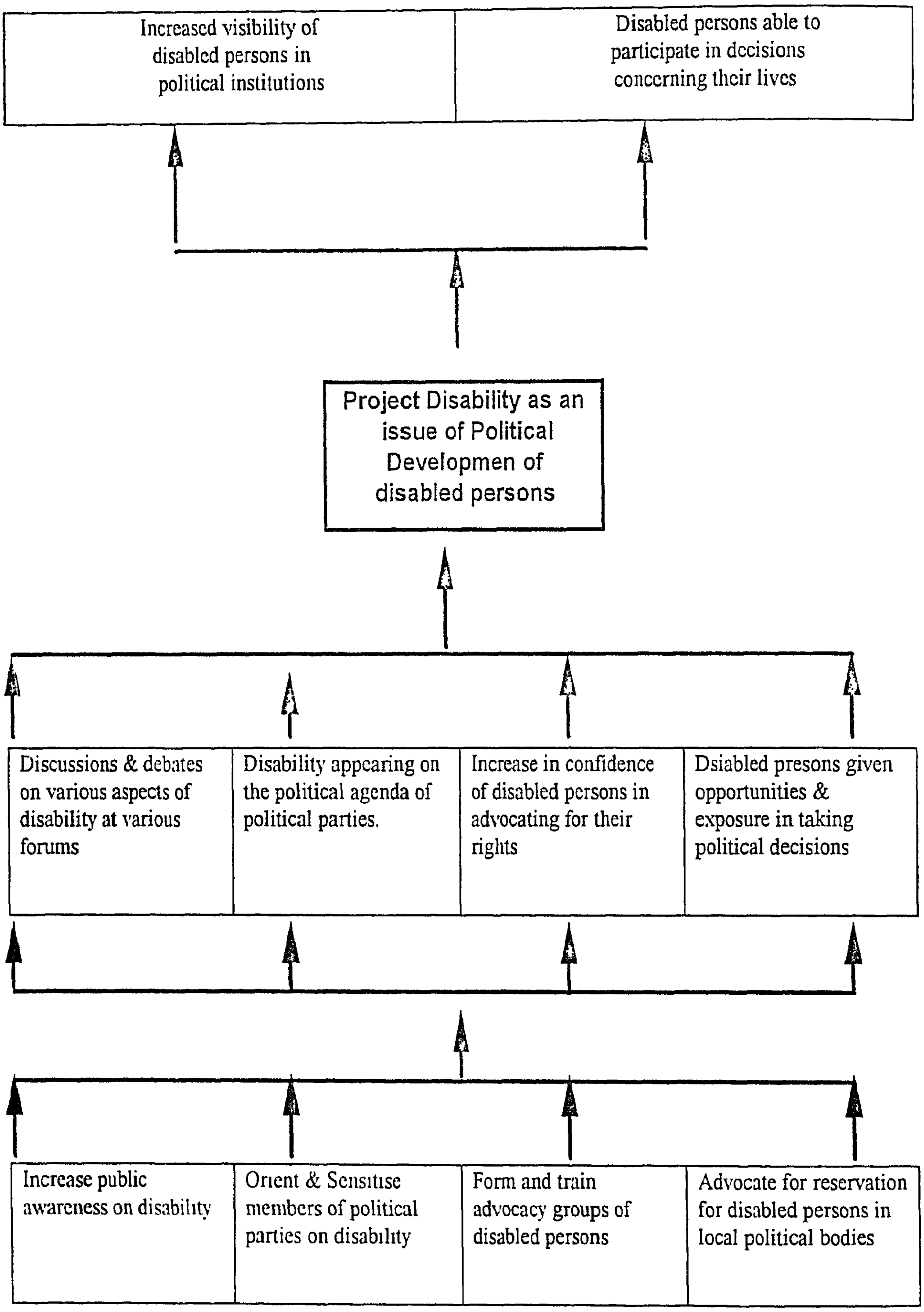


Total rehabilitation of disabled persons, that is, living their life with dignity and recognised for their contribution in to the society

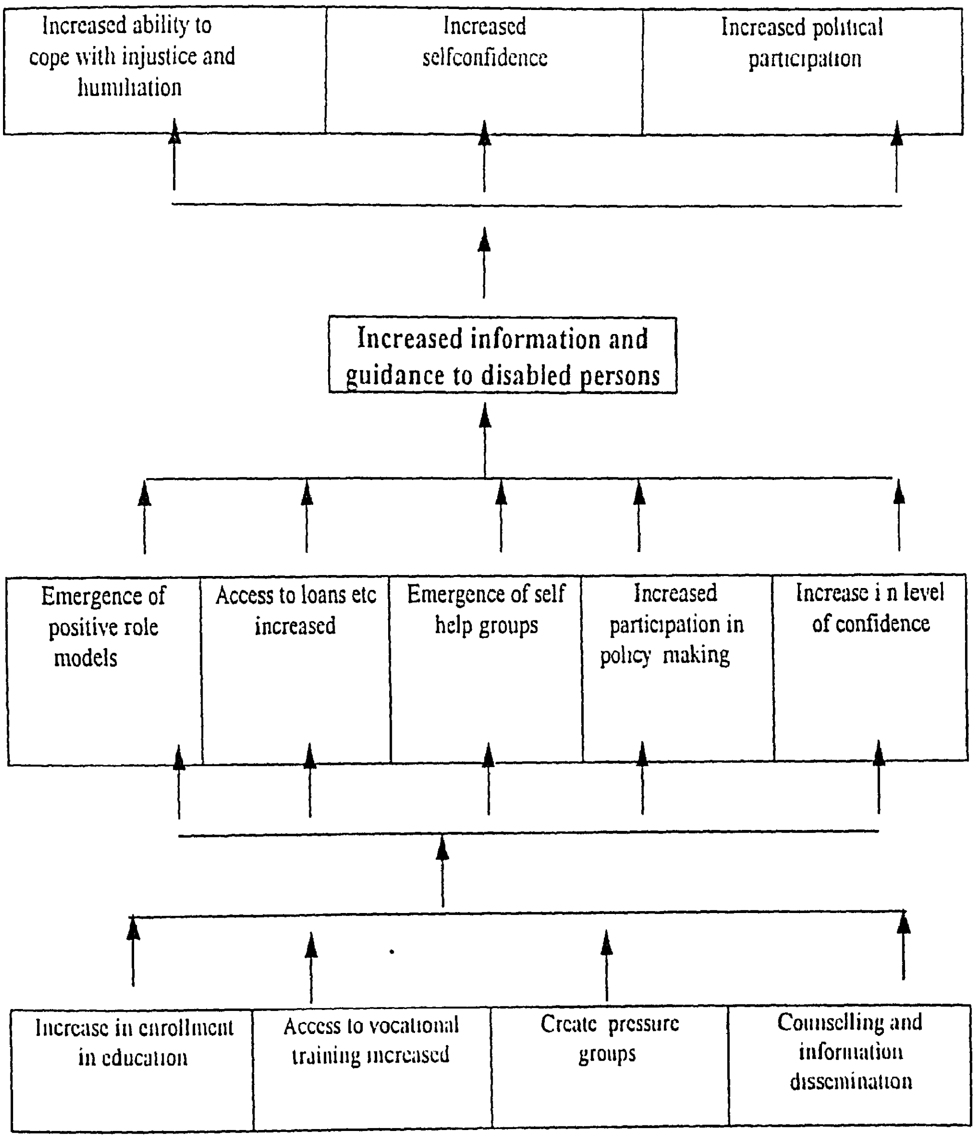
Disabled persons
able to realise their full potential
socially integrated in the society
live an independent life
able to deal with injustices and humiliation

| | | | | |
|---|---|---|---|---|
| Increase in infrastructur and outreach of services | Increase in capacities of of parents to assist and support disabled persons | Increase in the level of awareness of the community | Increased information and guidance to disabled persons | Project disability as an issue of political developmt of persons with disability. |

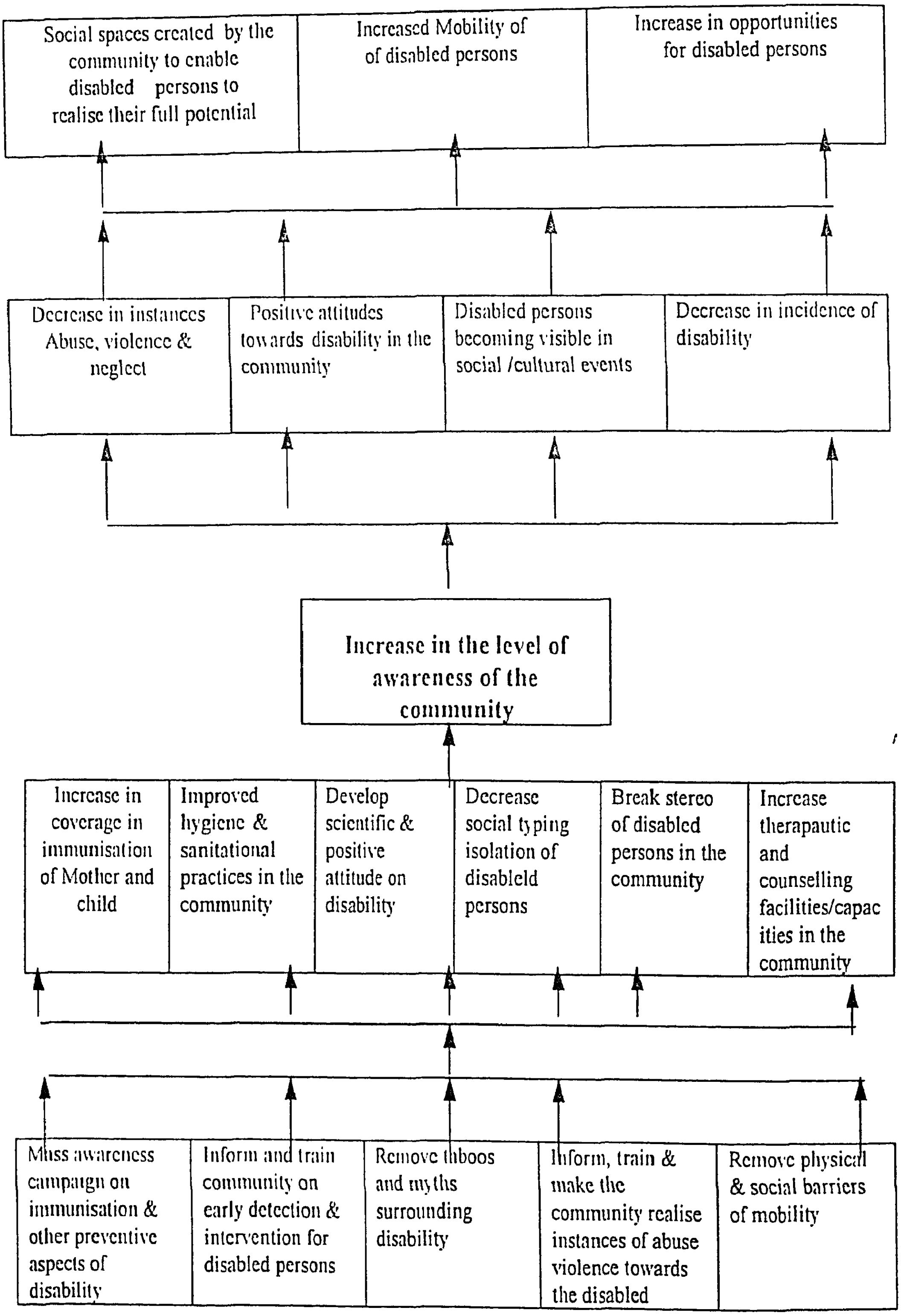
OBJECTIVE TREE

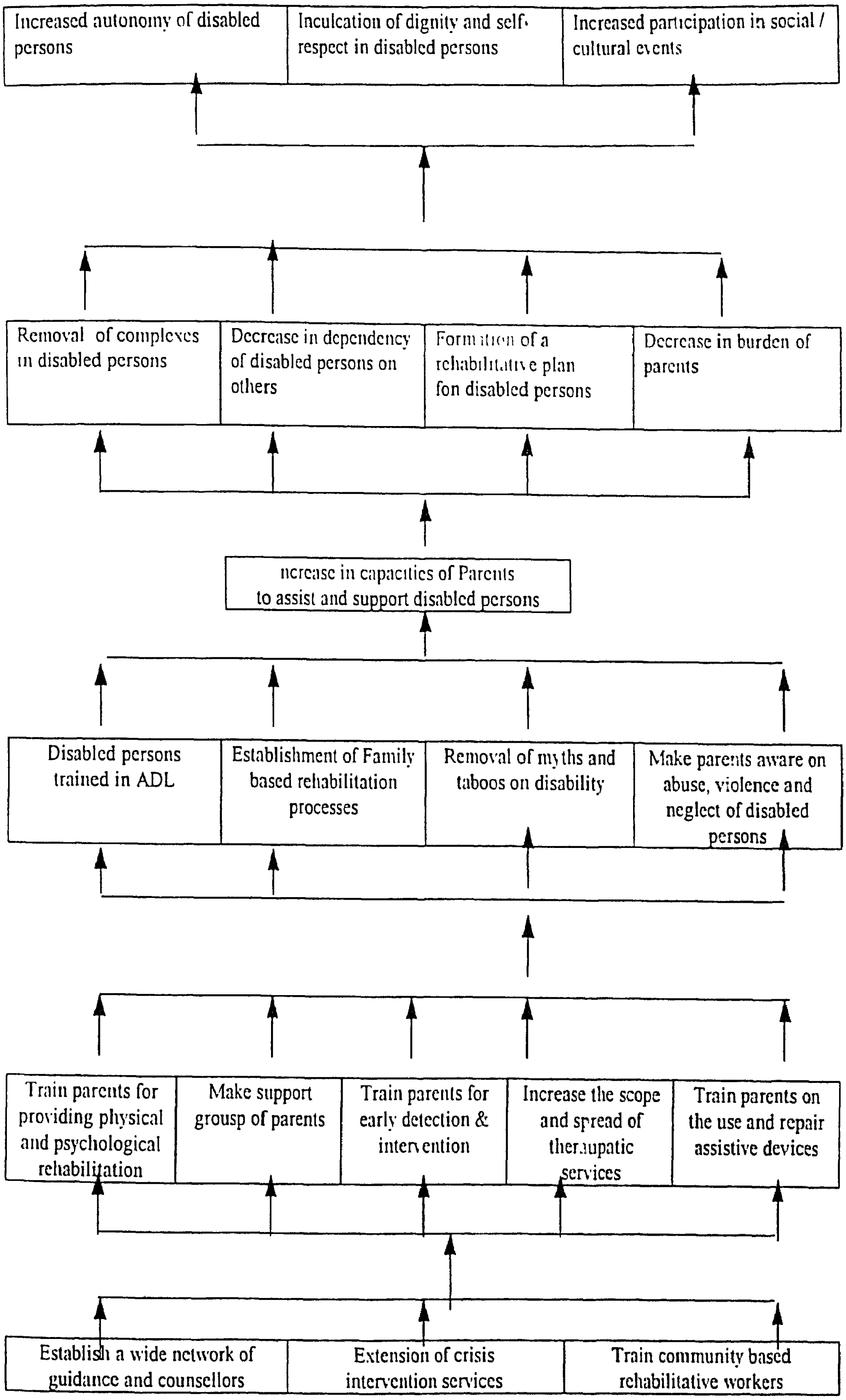

Increased visibility of disabled persons in political institutions
Disabled persons able to participate in decisions concerning their lives
Project Disability as an issue of Political Developmen of disabled persons
Discussions & debates on various aspects of disability at various forums
Disability appearing on the political agenda of political parties.
Increase in confidence of disabled persons in advocating for their rights
Dsiabled presons given opportunities & exposure in taking political decisions
Increase public awareness on disability
Orient & Sensitise members of political parties on disability
Form and train advocacy groups of disabled persons
Advocate for reservation for disabled persons in local political bodies

OBJECTIVE TREE

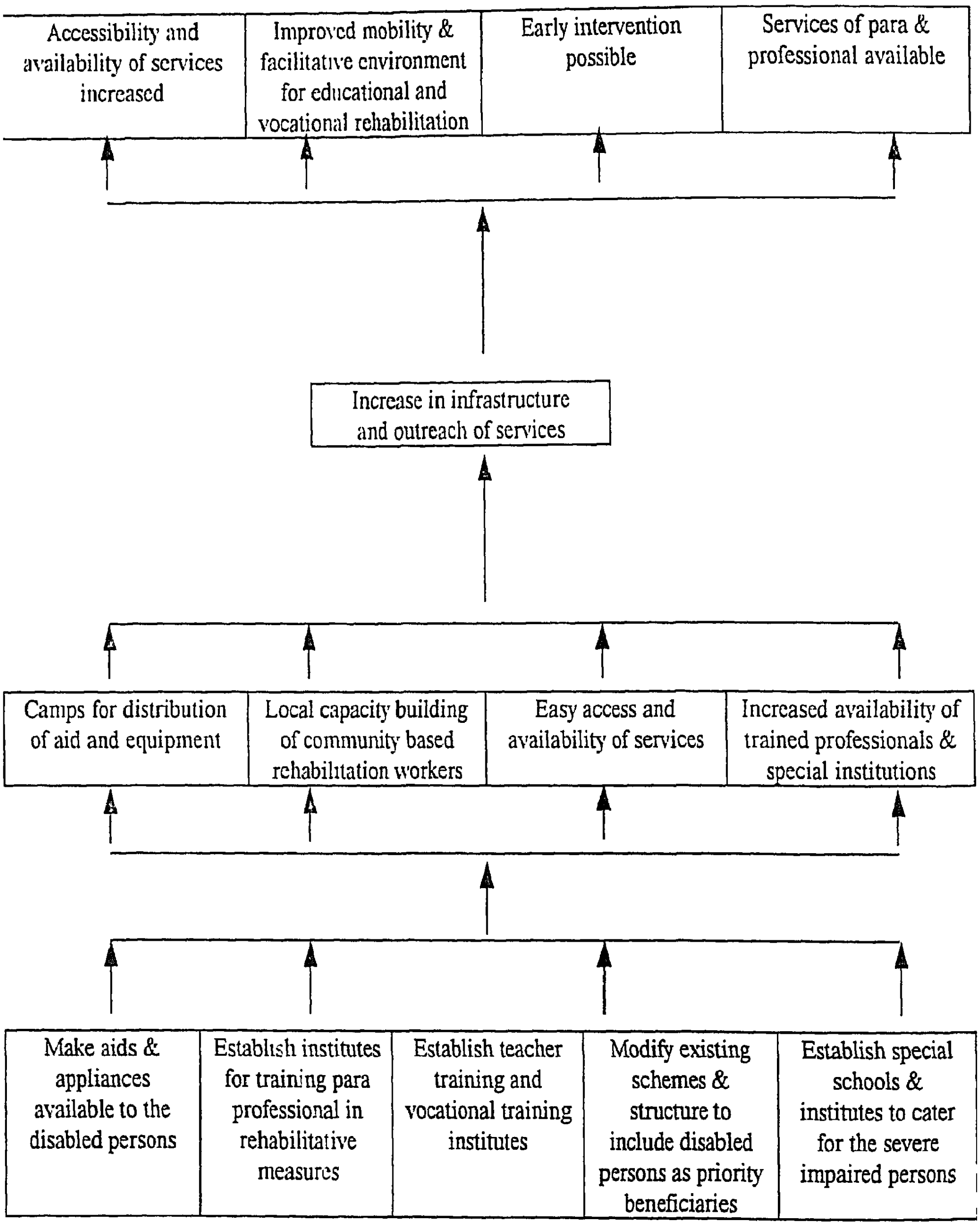

Increased ability to cope with injustice and humiliation
Increased selfconfidence
Increased political participation
Increased information and guidance to disabled persons
Emergence of positive role models
Access to loans etc increased
Emergence of self help groups
Increased participation in policy making
Increase i n level of confidence
Increase in enrollment in education
Access to vocational training increased
Create pressure groups
Counselling and information dissemination

OBJECTIVE TREE


Social spaces created by the community to enable disabled persons to realise their full potential
Increased Mobility of of disabled persons
Increase in opportunities for disabled persons
Decrease in instances Abuse, violence & neglect
Positive attitudes towards disability in the community
Disabled persons becoming visible in social /cultural events
Decrease in incidence of disability
Increase in the level of awareness of the community
Increase in coverage in immunisation of Mother and child
Improved hygiene & sanitational practices in the community
Develop scientific & positive attitude on disability
Decrease social typing isolation of disableld persons
Break stereo of disabled persons in the community
Increase therapautic and counselling facilities/capacities in the community
Mass awareness campaign on immunisation & other preventive aspects of disability
Inform and train community on early detection & intervention for disabled persons
Remove taboos and myths surrounding disability
Inform, train & make the community realise instances of abuse violence towards the disabled
Remove physical & social barriers of mobility


Increased autonomy of disabled persons
Inculcation of dignity and self- respect in disabled persons
Increased participation in social / cultural events
Removal of complexes in disabled persons
Decrease in dependency of disabled persons on others
Formation of a rehabilitative plan fon disabled persons
Decrease in burden of parents
ncrease in capacities of Parents to assist and support disabled persons
Disabled persons trained in ADL
Establishment of Family based rehabilitation processes
Removal of myths and taboos on disability
Make parents aware on abuse, violence and neglect of disabled persons
Train parents for providing physical and psychological rehabilitation
Make support grousp of parents
Train parents for early detection & intervention
Increase the scope and spread of theraupatic services
Train parents on the use and repair assistive devices
Establish a wide network of guidance and counsellors
Extension of crisis intervention services
Train community based rehabilitative workers

OBJECTIVE TREE


Accessibility and availability of services increased
Improved mobility & facilitative environment for educational and vocational rehabilitation
Early intervention possible
Services of para & professional available
Increase in infrastructure and outreach of services
Camps for distribution of aid and equipment
Local capacity building of community based rehabilitation workers
Easy access and availability of services
Increased availability of trained professionals & special institutions
Make aids & appliances available to the disabled persons
Establish institutes for training para professional in rehabilitative measures
Establish teacher training and vocational training institutes
Modify existing schemes & structure to include disabled persons as priority beneficiaries
Establish special schools & institutes to cater for the severe impaired persons

OBJECTIVE TREE

## Status of CBR, in India

The first and the foremost concept of CBR approach is **coverage.** The challenge however is, to achieve optimum quality of services, given the limitations of scarce resources. Besides, the most positive aspect is "spontaneous rehabitation" that simulltaneously goes on at the family and community levels. The second principle has to do with **costs** which are affordable, particularly in the context of developing countries like India. The third principle pertains to **community participation** which means the active involvement of people with disabilities, their families and communities.

In CBR, the primary concern is to shift rehabilitation interventions from institutions to the homes of person with disabilities, thereby increasing coverage and reducing costs. The interventions are of two kinds. The first deals with specific individual oriented interventions, which look at reducing impairments and disabilities through medical rehabilitation, educational interventions etc. The second kind of intervention has to do with non specific community oriented interventions which seek to reduce the handicap faced by the person with disability. Examples of the second type of intervention are community education, awareness building, attitude change etc.

**However there is no universal model of CBR and it remains a highly contextual and dynamic approach depending on the social cultural and economic factors at a given time in a given place.**

In India, many CBR programmes have been promoted in the last 20 years, many of them by NGOs. The GOI, introduced the District Rehabilitation Centre schemes in 1985, but the programme, did not really take off, to cover all districts. The costs involved are inhibitive and the scheme has all the dysfunctional aspects of a typical bureaucracy. Subsequently, different schemes have been planned to achieve coverage in rural areas, but none of these have reached the stage of implementation. The Ministry of Health has also announced its intention to launch CBR projects as part of its PHCs. The Council for Advancement of Peoples Action and Rural Technology (CAPART), has recently joined the bandwagon, looking at integration of CBR and concern of people with disabilities, into rural development programmes.

DRC scheme was started by the GOI in 11 districts in the country in 1985. IIM Ahemadabd evaluated the DRC scheme in 1989. It was revealed that the DRCs have not been able to cover the mentally disabled and the visually impaired groups properly. Only 35% needs of education and 10% needs of vocational training could be meet through the DRC scheme. DRCs were found lacking in evoking community awareness and involvement in their areas of operation. The finding also showed that DRCs did not contribute in a major way towards detection of disability. This scheme also failed to coordinate effectively with the NGOs working in this field in their respective areas.

A voluntary organisation SEVA-IN-ACTION is working in Bangalore with C.B.R. of the disabled. The pivotal role here is of the multipurpose rehabilitation worker (MRW) at the sub divisional level (Taluka level), who is a paid employee and who looks after a population of about one lakh. At the panchayat level, committee has been envisaged to manage the CBR programme. A facilitator has been envisaged for each panchayat (average 5000 population). MRWs working for a population of about one lakh, are provided a training of 18 months at the State Training Institute. This programme is running in Bangalore for the last many years and is confined to a Taluka. The programme has not spread beyond this area.

The Government of India has recently issued a few guidelines and sought opinion of the states on the proposed "National Programme for Rehabilitation of the Disabled" (NPRD). This programme also revolves around Community Based Rehabilitation. In the proposed system, there would be two paid workers (one male and one female ) for a population of 5000. At the PHC level there would be two Multipurpose Rehabilitation Workers. At the district level there would be a District Resource Centre. A Resource Centre is envisaged at the state level too.

It is now obvious that there cannot be nationwide uniformity in any single model that is applicable every where. However a CBR network spanning the entire country needs to be evolved under a broad frame work that has to be nationally acceptable, within an overall cost ceiling within which considerable flexibility should be provided to take into account the local talent, resources and infrastructure that is available in a particular place.

The project proposed here, differs significantly from the ones mentioned above. Besides emphasizing more on community participation, it relies primarily on voluntary efforts. There are no paid employees below the Janpad level. At the Janpad level too, only one person is a paid employee. Similarly, instead of the expensive concept of District Rehabilitation Centre (with one time expenditure of around Rs. Ten lacs and recurring expense of round Rs.15.00 lacs every year) this project emphasizes on voluntary efforts together with coordination and pooling of existing resources. Cutting down of bureaucracy is one of the salient features. Bureaucracy once created tends to perpetuate itself. Sustainability of the project is another important aspect taken care of, here. Thus the model of CBR is quite different from the others and would take care of the state of Madhya Pradesh at a much lower and affordable cost. This project would be specific to the need of this state and is tailor made, looking to the existing systems, conditions and structures. The project would be self sustaining and will depend entirely on community support and participation.

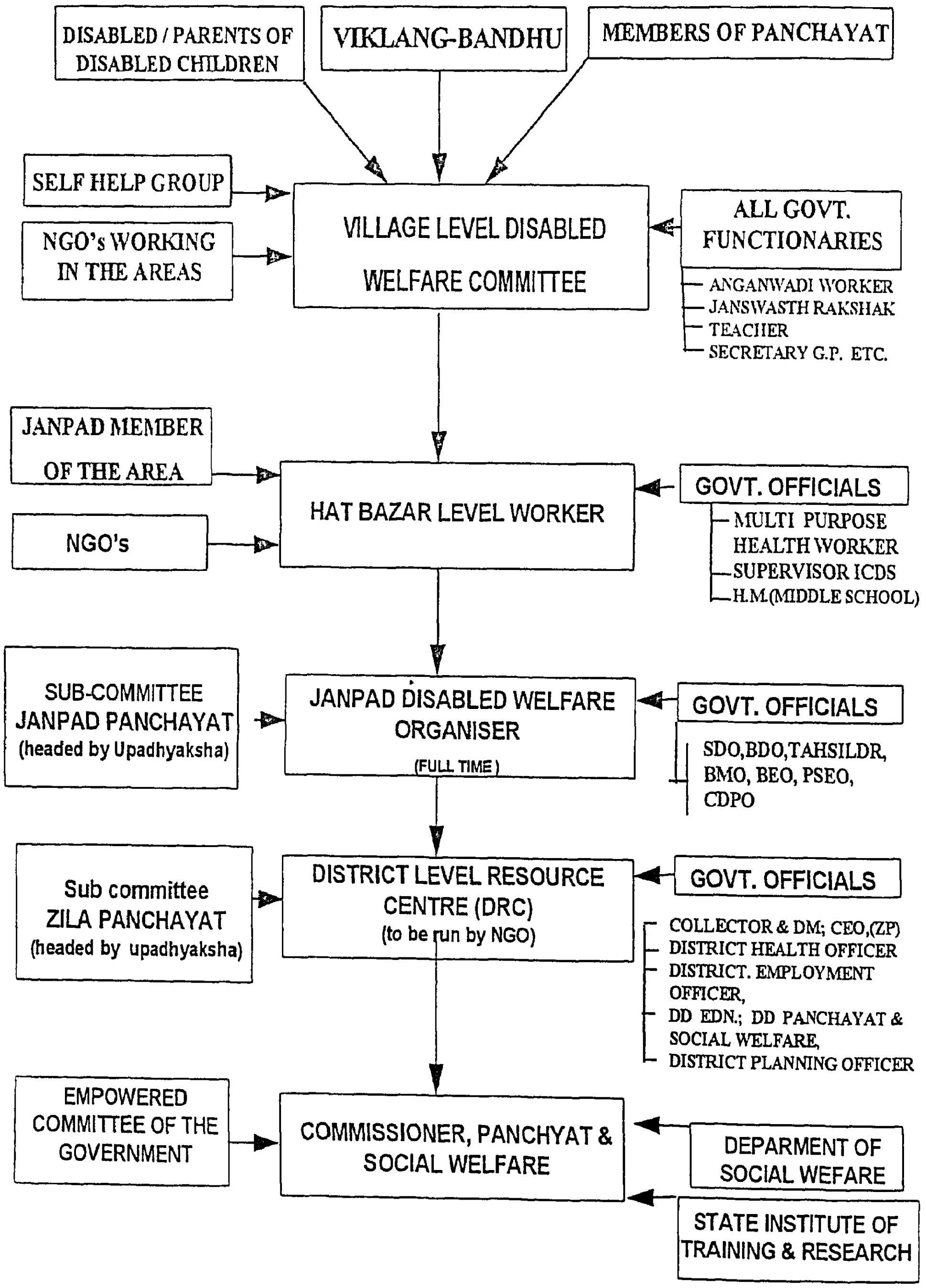
The person at the cutting edge is ' Viklang-Bandhu ' the voluntary worker for the welfare of the disabled persons in every village. He is further supported by the " Hat Bazar stariya karyakarta" i.e. the Hat Bazar Level Worker. Both these workers would be voluntary. ( The Hat Bazar level worker may be reimbursed every month the actual expenses incurred on items like transportation and incidental charges that he incurs ). In the proposed project, existing district hospital will be equipped to provide all medical support and the administrative support will be provided by an NGO. It will not be a govt. body as is proposed under NPRD and many other projects mentioned above. Similarly all the workers below the Janpad level would be voluntary. This has been done looking to the past experiences of the projects taken up for such social causes. In such projects, the work never really reached its logical goal, because of the vested interests of the bureaucracy, that was evloved, which gave more importance to continuanace of their job than to the fulfilment of the project goal.

## 10. Structure of the service delivery system: committee's at various levels.

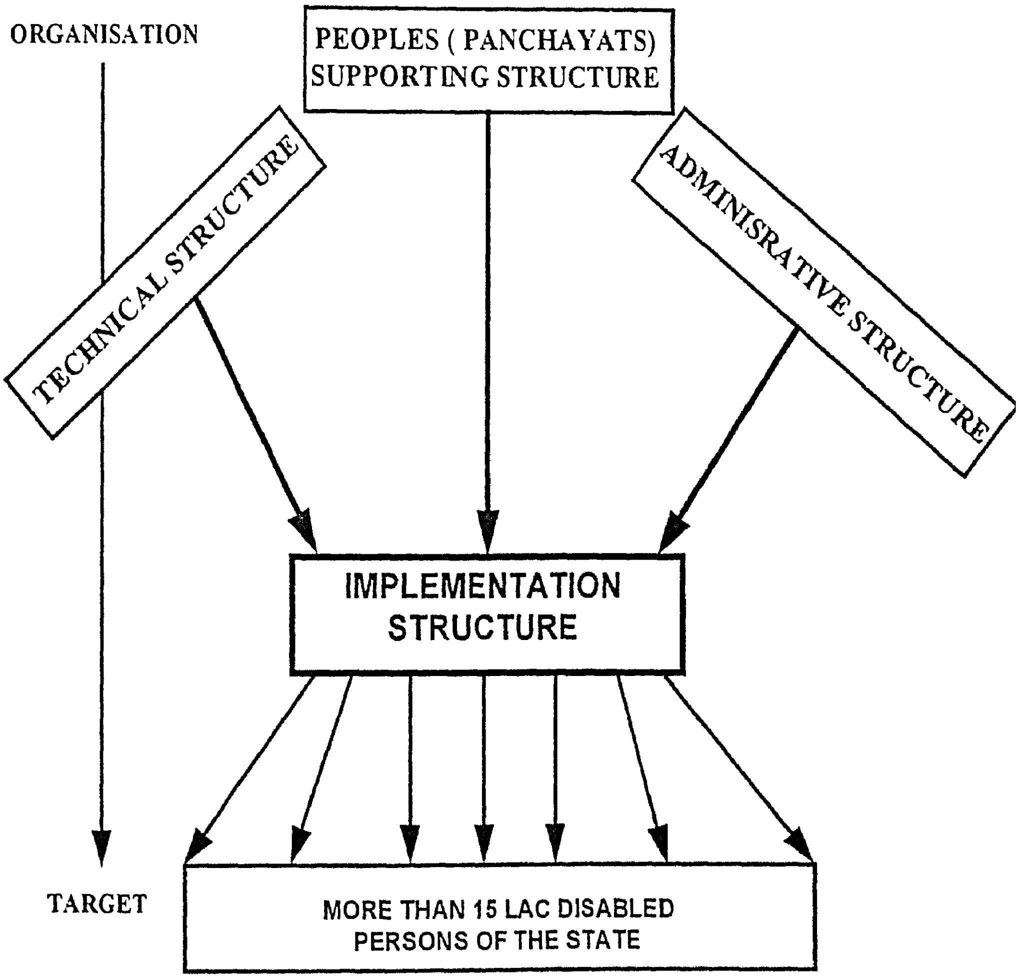
Structural organization of the CBR programme proposed here follows essentially the disability rehabitation model, which classifies rehabilitation services into (a) Medical (b) psychological (c) educational and (d) socio-economic rehabilitation. The structural organization caters to the outreach need of the programme, making services available in the rural areas, so that people automatically utilize the services. Leadership will be provided by the Panchayat office bearers at all levels.

The service delivery for the CBR model at various level has to be clearly defined. It can be shown pictorially as below :-

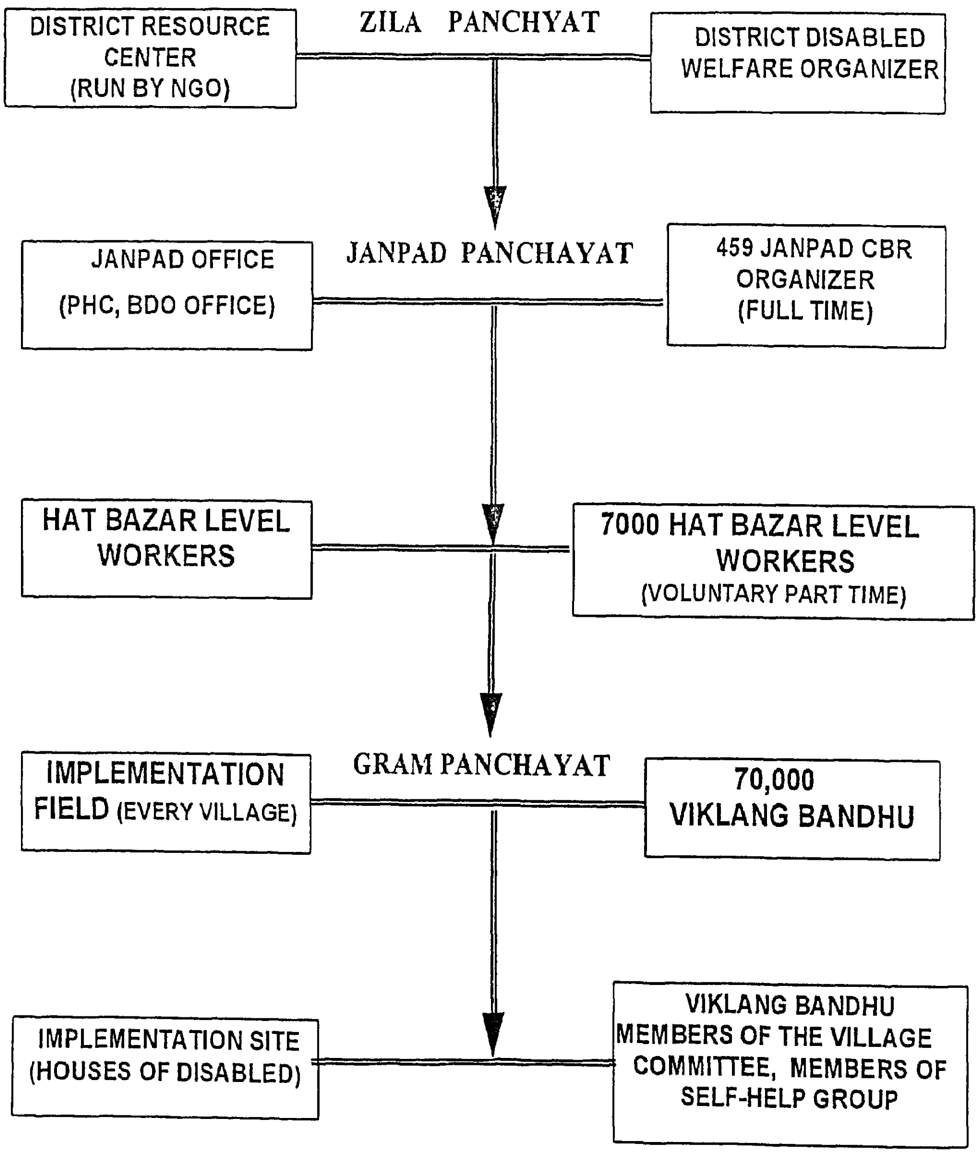
# *STRUCTURAL ARRANGEMENT*


DISABLED / PARENTS OF DISABLED CHILDREN
VIKLANG-BANDHU
MEMBERS OF PANCHAYAT
SELF HELP GROUP
NGO's WORKING IN THE AREAS
VILLAGE LEVEL DISABLED WELFARE COMMITTEE
ALL GOVT. FUNCTIONARIES
ANGANWADI WORKER
JANSWASTH RAKSHAK
TEACHER
SECRETARY G.P. ETC.
JANPAD MEMBER OF THE AREA
NGO's
HAT BAZAR LEVEL WORKER
GOVT. OFFICIALS
MULTI PURPOSE HEALTH WORKER
SUPERVISOR ICDS
H.M.(MIDDLE SCHOOL)
SUB-COMMITTEE JANPAD PANCHAYAT (headed by Upadhyaksha)
JANPAD DISABLED WELFARE ORGANISER (FULL TIME)
GOVT. OFFICIALS
SDO,BDO,TAHSILDR, BMO, BEO, PSEO, CDPO
Sub committee ZILA PANCHAYAT (headed by upadhyaksha)
DISTRICT LEVEL RESOURCE CENTRE (DRC) (to be run by NGO)
GOVT. OFFICIALS
COLLECTOR & DM; CEO,(ZP)
DISTRICT HEALTH OFFICER
DISTRICT. EMPLOYMENT OFFICER,
DD EDN.; DD PANCHAYAT & SOCIAL WELFARE,
DISTRICT PLANNING OFFICER
EMPOWERED COMMITTEE OF THE GOVERNMENT
COMMISSIONER, PANCHYAT & SOCIAL WELFARE
DEPARMENT OF SOCIAL WEFARE
STATE INSTITUTE OF TRAINING & RESEARCH

# *OVERALL STRUCTURE*


ORGANISATION
PEOPLES ( PANCHAYATS) SUPPORTING STRUCTURE
TECHNICAL STRUCTURE
ADMINISRATIVE STRUCTURE
IMPLEMENTATION STRUCTURE
TARGET
MORE THAN 15 LAC DISABLED PERSONS OF THE STATE

# *IMPLEMENTATION STRUCTURE*


DISTRICT RESOURCE CENTER (RUN BY NGO)
ZILA PANCHYAT
DISTRICT DISABLED WELFARE ORGANIZER
JANPAD OFFICE (PHC, BDO OFFICE)
JANPAD PANCHAYAT
459 JANPAD CBR ORGANIZER (FULL TIME)
HAT BAZAR LEVEL WORKERS
7000 HAT BAZAR LEVEL WORKERS (VOLUNTARY PART TIME)
IMPLEMENTATION FIELD (EVERY VILLAGE)
GRAM PANCHAYAT
70,000 VIKLANG BANDHU
IMPLEMENTATION SITE (HOUSES OF DISABLED)
VIKLANG BANDHU MEMBERS OF THE VILLAGE COMMITTEE, MEMBERS OF SELF-HELP GROUP

**The Viklang-Bandhu :**

His/her functions would include, inter-alia-

1. Provide preliminary therapies in the form of exercises.
2. Speech training / language development
3. Preliminary orientation and mobility training to the visually disabled
4. Activities of Daily Living (ADL) and behavioural training to the mentally retarded.
5. Minor repairs in aids and appliances / preparation of low cost aids and appliances.
6. Preliminary home training to the parents of the disabled children. Establish rapport with the parents of the disabled.
7. Follow-up of the use of appliances
8. Ensure education of all the disabled children.
9. Ensure Non-formal education of the disabled adults.
10. Help in early detection and intervention in all cases of disability.
11. Counselling to the individual and the family
12. Ensure sanction / regular distribution of scholarship.
13. Ensure sanction / regular distribution of social security pension.
14. To help the disabled in getting loans for self employment under schemes like IRDP; PMRY;SC;ST;OBC, Development and Financial Corporation loans.
15. To ensure selection of disabled beneficiaries by the Gram Sabha for Poverty Alleviation Programmes like Indira Awas Yojana, Million well scheme etc.
16. Ensure all other benefits of various govt. schemes and programmes.
17. Leisure and recreational aspects of the disabled. Ensuring playground activities of the disabled. This also works as "play therapy".
18. Assist in preventive programmes like immunization, use of Iodized salt etc.

19. House to house survey for screening and detection of cases with disability.

20. Promotion of self-help groups.

*The Viklang Bandhu will function with the support of* **"Village disabled welfare committee"**. Members of the Panchayat, Disabled persons, parents of the disabled children, NGOs and government functionaries will be the members of the village committee. The village committee will be headed by the Sarpanch of the Gram Panchayat.

**Hat Bazar level worker** :

Hat Bazar is a weekly market having a catchment of 8 to 12 villages on an average. Madhya Pradesh has an age-old and very popular tradition of Hat Bazars. Rural folk of the catchment area visit the Hat Bazar on the week-day with whatever little surplus they have in terms of kind or cash, Hat Bazar provides them an opportunity to buy goods of their need. It is also a social occassion, where the rural folk meet friends and relatives. In tribal areas, this probably is the only place where the tribal folk come in contact with the outside world. It serves as a window to them to interact with the outsiders. The Hat Bazar centre is usually a bigger and centrally located village, with better infrastructure. Often, it is the headquarter of government functionaries like Patwari, Auxiliary Nursing Midwife (ANM), Multipurpose Health Worker(MPW), Supervisor (ICDS), etc. It is customary to attend these Hat Bazars, and rural folk attend it, even if they do not have any business to transact there.

The functions of Hat Bazar Lavel Worker would include -

1. Provide support to the Viklang Bandhu in carrying out his work.
2. Monitoring the work of the Viklang-Bandhu.
3. Provide technical guidance and support to the Viklang Bandhu.
4. Wherever necessary, refer difficult cases coming from the Viklang-Bandhu to the Janpad CBR Organiser or District Resource Centre.

5. To work as a link between the Viklang Bandhu and the Janpad CBR organizer.
6. To take feed back from the Viklang Bandhu and pass it upwards.
7. Community mobilization.

The Hat Bazar level worker will get support from the Janpad members of the area.

**The Janpad CBR Organiser**

The Janpad CBR organiser will work under the guidance of the Janpad Panchayat sub-committee that looks after social welfare. He will get support from all the concerned officers like SDO, BDO, Block Medical Officer, Block Education Officer, Panchayat Social Education Officer, Child Development Project Officer etc.

Functions of the Janpad CBR Organiser would include :

1. Provide Medical / Health Services to the cases referred by the Hat-Bazar Worker / Viklang - Bandhu, through the Primary Health Centre.
2. Monitor the work of Hat-Bazar Worker and Viklang- Bandhu.
3. Provide guidance in difficult cases.
4. Provide elementary therapies to the needy.
5. Get feed back about the field work and to take corrective measures.
6. Selection of Voluntary Workers, through the Grame sabha. Select new workes if and when the old worker ceases to work,
7. Co-ordinate with the BDO for getting the self-employment cases sanctioned through the the banks.
8. Co-ordinate with the Janpad staff for sanctioning the Social Security Pension cases and scholarship cases of the eligible disabled persons.
9. Help organising camps when the DRC team arrives at the scheduled date for providing therapies, aids. appliances, artificial limbs etc.
10. Follow up and maintenace of records and documents.
11. Sending reports to the District CBR Organizer.

12. Coordinate with the Block Education Officer to facilitate Integrated Education for the Disabled (IED)
13. To coordinate with the CDPO for the pre-natal, peri-natal and post natal care of mother and the child. Takes steps for prevention of disabilities.
14. Refer difficult / severe cases to the DRC.
15. Repairs of aids and appliances. Most of the appliances distributed earlier keep lying idle, for want of minor repairs.
16. Vocational training through Rural ITI's, Mini ITI's, ITI's.
17. Training to the Viklang Bandhu / Hat Bazar level workers
18. Coordinate with all other departments to ensure flow of benefits / services to the disabled.
19. Community mobilization.

### DRC and District CBR. Organiser

The DRC envisaged here is very different from the one started by the Govt. of India. Most of the medical facilities like speech therapy, corrective surgery etc. would all be provided in the district hospital itself, where the concerned doctors would be properly oriented towads CBR. The DRC would be run by an NGO and will have orthotic and prosthetic workshop (where work will be done by skilled workers on contract), occupational and physio theraphist, one or two clerical staff and one accountant. In addition the DRC would be equipped with one or two experts needed to deal with the kind of disability prevalent more in that particular district. The staff in the DRC would be need based and would be minimum possible. It will be headed by District CBR Organiser. This person would be from the NGO running the DRC. The Distt. CBR Organiser would function under the overall guidance of the subcommittee of the Zilla Panchayat looking after social welfare. The Distt. CBR organiser will get support from all govt. functioneries like District Magistrate, District Health Officer, District Women and Child Development Officer, Dy.Director Panchayat & Social Welfare, Dy. Director Education, District Employment Officer, etc.

The functions of the District CBR organizer and DRC would include :-

1. Ensure training for upgradation of skills at all levels.
2. Coordinate with the cell in the District Hospital to provide corrective surgery and other specialised services.
3 To provide aids and appliances needed for the physical rehabilitation of the disabled. This will be done through camps at the Janpad level The DRC will maintain a workshop for aids and appliances.
4. Coordinate with Education deptt. for ensuring education to all the disabled (IED and NFE).
5. Coordinate with the Manpower Planning deptt. to ensure - Vocational training through Rural ITIs, Mini ITIs, ITI's, and Polytechnic Colleges. Ensure job placement.
6. Act as a Watch-dog for the implementation of the Persons with Disabilities Act of 1995. Cases of breach would be brought to the notice of the "Commissioner for persons with Disabilities".
7. Help opening of special schools; coordinate with, special schools for the severely disabled.
8. Run the CBR in the district, lookafter the administrative and financial aspects.
9. Documentation; reporting to the state cell.

## Delivery System for CBR at the State level

At the state level, rehabilitation cell will be set up under the Commissioner for Panchayats and Social Welfare. This cell will provide support and assistance to the District Rehabilitation Centres and to the District CBR organiser.

**Functions of this cell would include -**

1. To look after the training needed of the programme; develop material; arrange for the resource persons. It would also arrange to train the NGOs.
2 Arrange for the finances needed at the DRC level.

3. Coordinate with all Govt. departments and the "Commissioner for persons with disabilities".
4. Provide technical inputs, where ever needed, to the DRC in cooperation with the National Institutes.
5. Documentation and dissemination of information. This cell will keep a record of all relevant data and publish hand bills etc. for public education.
6. Coordinate the activities of various DRCs to meet regional demands.
7. Monitoring and evaluation.

## 11. ENVIRONMENT BUILDING

The success of this compaign depends on the effectiveness of the publicity compaign for enthusing and inspiring the community. This has to be done in a variety of ways making use of all kinds of media and methods. The success of CBR lies in the total involvement of the entire society / community. Publicity and motivation compaign has to be started much before the actual selection of Viklang-Bandhu takes place in the Gram sabha. This initial exercise has to be initiated by the state govt with the help of Panchayats and NGOs already working in this field. This will motivate the community at large and the potential volunteers in particular to take upon themselves this onerous task. The Viklang Bandhu, Hat-Bazar level worker, Janpad CBR organizer, District CBR organizer, the disabled and all the supporting committees shall be motivated.

A high pitch publicity is a must for the programme. Considering the fact, that the rehabilitation of the disabled starts in the family setting itself and family members have the most significant role to play in the entire process of rehabilitation, proper orientation and motivation of the family members is an equally important part of the publicity campaign. Sibling care and rehabilitation would be given equal focus in the publicity strategy. This would also mean a campaign for community information because many aspects pertaining to the causes of disability and status of the disabled are not even understood properly by the community itself. The "Jatha type activities" would include use of songs, street plays, and dance drama troupes to convey awareness about disability. It will also include padyatra, procession, use of local art forms.

The other kind of publicity activities would include, holding exhibitions, distribution and display of posters, leaflets and handouts, use of hoardings, publicity through. All India Radio, Television, use of film shows, slides in theatres, distribution of badges to school students and their parents etc.

Kalapathak (the cultural troupes) in every district would prepare special programmes in the form of songs, dances and skits, keeping the local forms of folk dances and folk art, intact. During the World Disabled Day on 3rd December, seminars would be organised at the state and district level to discuss ways for complete rehabilitation of the disabled. With community realising the significance, the programme is bound to figure in the agenda of the politicians too. The entire process of rehabilitation of the disabled has remained neglected so far, because of lack of political-will. As it moves centre stage, the programme is bound to get more focus and push.

## 12. Training of the Volunteers/Organisers :

Viklang Bandhu would be selected for each and every village of the State in the Gram Sabha. A Special Campaign would be launched to ensure participation of all disabled people of the Gram Panchayat in the Gram Sabha. Viklang Bandhu would be selected on purely voluntary basis. He / she may be a disabled also. Training 70,000 odd Viklang- Bandhus spread all over the state is an uphill task. Added to this, are the Hat Bazar level workers about 7000 in number. Their training needs would also have to be met.

The voluntary workers are presently oriented by the Govt. Regional Rehabilitation Training Centre for a period of three months. This training being too long, the voluntary workers loose interest after some time. More-ever it is difficult to identify people who would spare three month in one-go. For the purpose of this project, the training module could be compressed to a period of 14 days, to begin with. After initial orientation of two weeks the voluntary workers would be sent back to begin work in the field. After they start working in the field and come across field level problems, they may be further oriented for one week after a period of about 6 months. This would also help in screening those, not interested, from the genuinely motivated workers.

To train a volunteer army of about 80,000 people a large network of resource persons, master trainers and trainers are needed. At the State level their would be a core group of key resource persons drawn from the specialists in Orthopaedics, Mental retardation, ENT experts, Rehabilitation experts and NGOs. The source would be-medical colleges of the State, Govt. officers and NGOs. This core group would train a group of master trainers about eight for each district. A typical team of master trainers would include doctors in orthopaedics, Psychology, ENT Specialist, Rehabilitation worker, Physiotherapist, Occupational Therapist and staff from NGOs already working in the field. The team of master trainers in each district (some of whom could be those manning the DRCs) would train a team of trainers for each Janpad ( 459 in the State). This team would consist of Janpad CBR Organizer, Block Medical

Officer, Child Development Project Officer, The Panchayat and Social Extension Officer (PSEO) and a paramedical staff of the Public Health Centre (PHC) situated at the blocks head quarter. The master trainers would be imparted a training of three days at the State Head Quarter. The trainers would be imparted a training of one week at the district head quarter. The training schedule may appear too short, specially for voluntary disability workers, but looking to the enormity of the problem and the vast extent of the problem this seems to be the only way out. Moreover, as stated earlier, it is difficult to draw the people for more than two weeks at a time on voluntary basis. Deprofessionalising these services is the only answer for a gigantic problem as it exists in our state. Their would be second round of training of master trainers, and the volunteers after six months. The Hat Bazar level worker would be imparted a training of two weeks to begin with, followed by second round of one week training after six months and one week training every year for three years.

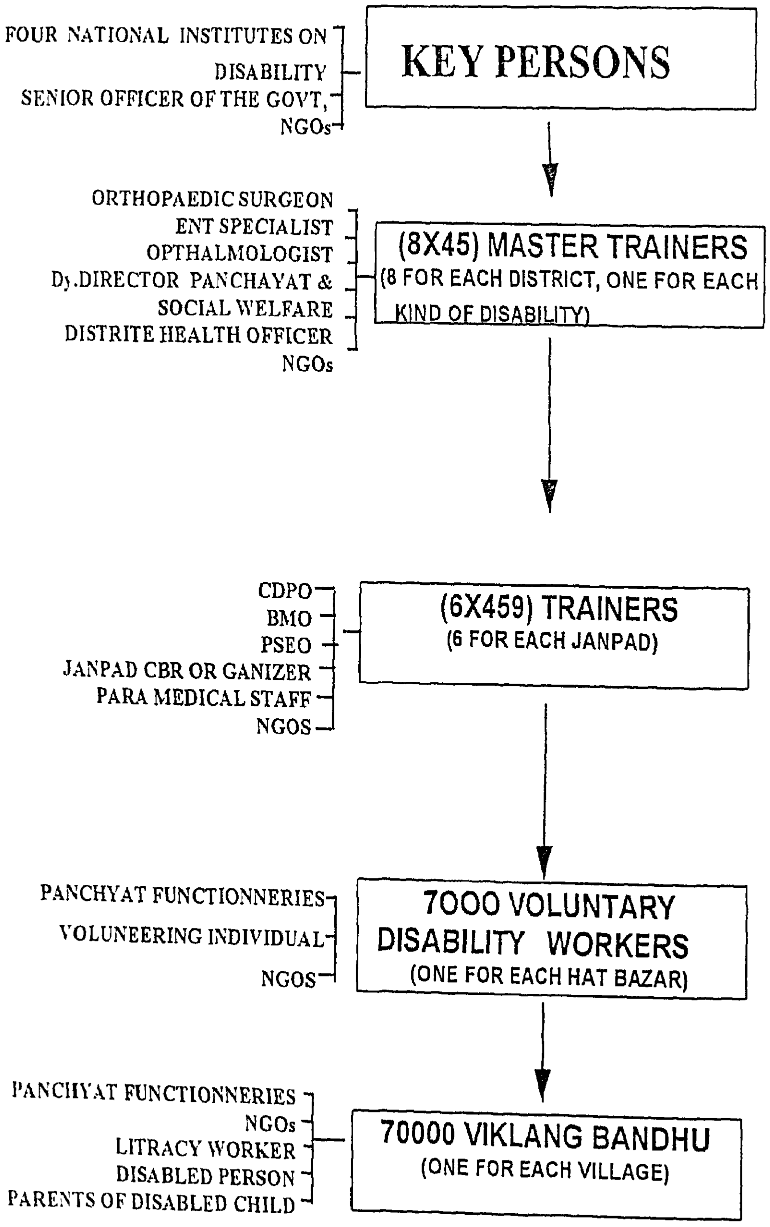
The Janpad CBR organiser would be imparted a training of three months at the divisional head quarters. This training would be provided either through RRTC or through the State Institute of Disability Rehabilitation (SIDR).

Madhya Pradesh is a vast state, and certain regions have higher incidence of a particular kind of disability. While the incidence of leprosy is higher (and consequently higher number of leprosy cured cases) in Chattisgarh region, more of paralysis (letharism) cases have been reported in Baghelkhand area due to consumption of khesari dal. Iodine deficiency (and consquently children with low iQ ) has been reported more in the Vindhyan belt, comprising mostly of the Mahakoshal region. There are higher number of cases of upper limb, amputees in areas with more cheff-cutters Similarly, there are higher number of amputees in areas from were high-ways pass; because of higher incidence of road accidents.

The training input in a particular destrict / region would focus more an the disabilities which have higher incidence in that area.

While imparting training to the volunteers, more emphasis has to be given on handling mentally retarded cases. Training on ADL (Activities of Daily Living) and the avenues open for mentally retarded cases would be dealt with suitably at greater length during the training.

# TRAINING STRATEGY



Experience of working in rural areas shows that village disabled give r-riding preference to socio-economic rehabilitation as compared to physical apies, rehabilitation trainings and mobility aids. The trainign curriculum must efore be geared to meet the needs of village disabled persons. The training iculum would also include exclusive section on communication skills and ort writing.

## Syllabus of "Viklang Bandhu" Training

14 days Training Programme (First Phase)

### First Day

- criterion for selection of Viklang Bandhu
- expectations from Viklang Bhandu
- how to conduct yourself in the village
- evoke the pride

### Second Day

- basic information regarding disability
- various causes of disability- various types of disability.
- plight of the disabled in the local area

### Third Day

- poliomyelitis
- cerebral Palsy.
- stroke

### Fourth Day

- contracture & deformity
- spinal chord Injury.
- leprosy.
- assistive appliances for locomotor disabled.

### Fifth Day

- physio-occupational therapy.
- information regarding rehabilitation.
- various stages of rehabilitation process

**Sixth Day**

- regarding visual disability.
- causes, treatment, education, vocational training
- socio-economic rehabilitation.
- orientation & mobility training

**Seventh Day**

- hearing disability-causes, intervention, education, training, socio-economic rehabilitation.

**Eighth Day**

- regarding mental retardation-causes, intervention, education, training, socio-economic rehabilitation.

**Ninenth Day**

- role of Viklang Bandhu.
- role of Hat Bazar level worker
- how to identify & survey disabled persons.

**Tenth Day**

- community based rehabilitation.
- airms, objects, community participation & mobilisation
- participation of government functionaries - local administration

**Eleventh Day**

- main provisions of "Persons with Disabilities Act, 1995".
- keeping records, monitoring,
- sending information

**Twelth Day**

Facilities & Schemes available to the disabled.

- Govt. Institutions for treatment, education, training & rehabilitation in the region.
- various NGOs working for the disabled in the region.
- social security pension.

- scholarship
- how to get aids & appliances.

**Thirteenth Day**

- self employment schemes
- poverty alleviation schemes.
- reservation of jobs in Govt. Services.
- various concessions & other facilities
- Vocational training facilities.

**Fourteenth Day**

- study tour to nearby special schools,
  treatment centres, vocational training centres to know about
  testing, valuation, examination of disabilities, therapies like Physio-
  Occupational therapy, Speech therepy, teaching techniques etc.

## 13. NGO Participation

NGO participation is the key to the success of the programme. The volunteers at the village and Hat Bazar level are individual non-governental contributions and form the backbone of the entire programme. NGOs would be helping in the following manner.

- NGO's would participate and take the lead in providing master trainers and voluntary workers at all levels.
- NGO's would also help in logistic support in organizing training to the volunteers.
- suitable NGO active in a particular district would run the DRC of the district headquarter. The District CBR organizer may be an active member of this NGO.
- The Janpad CBR organizer may be an active member of an NGO at the Janpad level.
- NGO's would be approached to open special schools for each kind of disability in each district.
- Monitoring of the programme at Janpad, District and state level would be done with the help of NGO's.

## 14. Economic Rehabilitation

Economic rehabilitation of the distabled is a precussor to social rehabilitation. Technical training would be provided to all those capable of it after providing them aids and appliances. Most of the training would take place under TRYSEM (Training of Rural Youth for self employment) regular poverty allevation programme being run in all the districts of the country by the Government of India. Those requring further specealized training would be trained for a period of 9 months in the Rural and mini ITI's and regular ITI's and Polytechnic. A campaign will be launched to clear the backlog for the technical training of all the deserving disabled persons. After about 3 years, When the backlog is cleared, 3% reservation for the disabled person in all such trainings would take care of the regular new requirement.

Special campaign will be launched to provide loans under poverty alleviation programmes to the eligible disabled persons. For the first 3 years the backlog would be cleared. There after the regular 3% reservation will take care of the new requirements. Sensitization of the Panchayat office bearers would ensure full understanding and help from them. If every gram panchayat resolves to provide two kiosks / small shops to the local disabled person at the local bus stand or some other vantage point it will take care of the economic rehabilitation of more than 60,000 disabled enterpreneurs. Similarly in the Hat Bazars (about 7000 in number in the state), if vantage places are allotted to local disabled persons by the Panchayat, it will take care of the economic rehabilitation of many disabled persons.

Female disabled persons may be particularly helped through decentralized forest nurseries. Persons with hearing impairement could be particularly rehabilitated in Agriculture and allied sectors. Their involvement in village watershed committees and Joint Forest Management Committees would be quite appropriate.

## 15. Facilities; Aids & Appliances :

As the Viklang-Bandhu starts working in the field and community awareness about the needs of the disabled increases, things are expected to look-up for the disabled. The Viklang Bandhu will make aware and help the eligible disabled in the village in getting their cases sanctioned for social security pension and scholarships. He would also help the disabled, get selected in the Gram sabha for beneficiary oriented schemes under self employment and poverty-allevation. It is expected that as the prgramme picks up, the speed of passing on the benefits of the govt schemes to the disabled will start getting accelerated. In a period of three to four years, it is expected to cover all the eligible disabled people and the backlog is expected to be cleared.

For aids and appliances to the disabled, the team from the district hospital and the DRC, would pay a visit to each Janpad headquarter periodically. This camp will be managed by the Janpad CBR Organizer with the help of Hat Bazar workers and Viklang-Bandhu. The expert services will be provided by the doctors from the district hospital and the Orthotic & Prosthetic engineers from the DRC. They will be supported by the BMO and his assistants posted in the PHC. Cases would be screened in advance by the BMO in the PHC, so that only the desiring cases come and in managable numbers. Corrective surgery may be carried out either at the PHC (if the operation theatre is available at the Janpad hq.) or would be referred to the district hospital. Necessary measurements will be carried out and required aids and appliances will be provided to the needy in the same camp or the next camp. Proper instructions, about ways of using the appliance, how to carry minor repairs etc, would also be given simultaneously.

Single window approach would be adopted for clearing of backlog in providing services / facilities and distribution of aids and appliances. The camp at the block headquarter or better still at the Hat Bazar-level, will clear all cases pertaining to social security pension, scholarships, identify card, passes for concessional travel in buses and trains and formalities of banks for loans under self employment. Viklang-Bandhu and Hat-Bazar volunteers will facilitate in smooth conduction of the camps and will help in completing the formalities. Follow-up, of all cases will be done by the Viklang-Bandhu, Hat-Bazar worker and the Janpad CBR Organizer.

## 16. Prevention :

Prevention of disabilities is a very vital aspect of the programme. Cent percent immunization of the children will ensure prevention of Poilo cases. The pulse-polio campaign being launched in the state for the last two years with the help of Rotary club and other NGOs has been a great success. This will continue for another 2 years. The Viklang-Bandhu would also help in creating awareness and bringing the children to the pulse polio centres on the appointed days.

Awareness about curability of leprosy, early detection and intervention will help curing leprosy patients through modified multi drug therapy. In a period of five years, all leprosy pateints could be brought under the fold of MMDT. Prevention mesures will ensure no more new cases.

Iodine deficiency - a major cause for the birth of mentally retarded children in the state has been brought under control through Rajeev Gandhi Iodine Deficiency Control Mission. A further boost to this mission will take place with the volunteers and the committees at all levels, spreading further awareness. Through the use of Iodized salt, it is expected to control this aspect within a span of three years time.

Regular health check up of the students in schools will ensure early detection of cases and partial prevention to that extent. The volenteers and committees at all level will facilitate and ensure this, every year.

District blindness control committees, already in position in every district; can depend on these volunteer and committees for helping them in early detection and intervention in cases of Cataract, Glaucoma and vitamin A deficiency .

Awareness in the community, with the help of proper training will help create a situation where accidental hazards on the roads, railway station, agricultural field, mines and work places, which lead to mutilation of body parts are reduced to a bare minimum.

## 17. **Education for the disabled** :-

At present only 19 districts in the state have the scheme of "Integrated Education for the Disabled" (IED). More so, this is being provided only in one or two schools at the district or block headquater. There is an urgent need to spread this to every school of the state for the benefit of mildly and moderately disabled children. At present only one resource teacher is available in these schools. This resource teacher has been trained in the "Regional School of Education, Bhopal" for a period of three months. Special chapter would be incorporated in the syllabus of the B.Ed. (Bachelor of Education) and D.Ed (Diploma in Education) courses itself. This chapter should cover all aspects, concerning education of various types of disabled students. Thus, all the qualified teachers would automatically get trained in IED. The existing untrained teachers, while undergoing routine training in the DIET (District Institute of Education and Training), would be trained on this aspect,as well. This would happen on regular basis. Thus, it would become possible to spread IED all over the state.

Under Rajiv Gandhi Mission for Primary Education, Madhya Pradesh has started "Education Guarantee Scheme". If a village or its hamlet does not have a school of any kind (Non formal included), within a radus of one km, for a group of students (40 in general areas, 25 tribal areas), the community can demand opening of a school. The government is bound to open a school there, within a period of 90 days. The teacher in this school is a local person, selected by the Gram Panchayat. This scheme has witnessed tremendous support and popularity in a short span of time. More than 13,000 such schools have started all over the state, with over 3 lakh students. About 2 lakh of them are girls These schools also have a large number of disabled children. In fact physical location of these schools in far flung areas is mainly responsible for the girl child and the disabled children getting more benefitted by this scheme.

For the orthopaedically disabled children, no separate school is required. The only arrangement required is to make the schools architechturally barrier free. This would be ensured by the village disabled welfare committee headed by the Sarpanch.

For severely disabled children, special schools would be needed. This is so because they need special care and treatment such as physiotherapy, occupational therapy, speech therapy and also some aids & appliances. They also need training for "Activities of Daily Lying" (ADL). Special schools would have residential facilities also because the catchment area of such schools has to be large. It would be appropriate to open at atleast one special school for each kind of disability in a district.

The model to be adopted for special education have would be a combination of the "Resource teacher model" and the "itinerant teacher model". While every rural school would be having a teacher trained to some extent, (though not to the extent of a Resource teacher), there could be a more trained Resource teacher, for every Hat Bazar area. This teacher would travel to the schools in the catchment area and offer assistance to children with special needs in these schools. Though the attention is diluted a little, but this seems to be the only solution for far flung rural areas.

For mentally retarded who are not educable and trainable, the Viklang-Bandhu has to concentrate on ADL (Activities of Daily Living ) along with the help of family members. Day care centres would be opened by the self-help groups to take care of the mentally retarded Suitable measures would be taken to prevent their sexual abuse too. For the hearing impaired, immediate need would be of audiometry test and provision of suitable hearing aid. This will help the child in easier and better receiption and learning. It will help in proper language and speech development. For the Visually impaired, provision and use of audio casettes and braille books is necessary.

Adequate provision of such aids, appliances and books would be made. with the Janpad CBR organizer, who would make these available to the Viklang-Bandhus on demand.

Jan Shikshan Nilayam (JSN) [Continuing Education Centres] working at Gram Panchayat head quarter would help the disabled children remain in touch with education. JSNs would keep books in braille for the use of visually impaired.

Teams would be formed in villages of retired teachers, ex servicemen, and literacy workers. These people would be given short term orientation courses and asked to take upon themselves the task of imparting non-formal education to disabled people.

The concept of open school would be used extensively to outreach the disabled students in the farflung areas. Suitable material would be prepared for the Visually-impaired in Braille. The disabled students could then take exams without attending formal classes. Councelling would have to be arranged through a system similar to that of itinerant teacher model i.e. the resource teacher at the Hat Bazar. Special schools are necessary for severely disabled. but for the student with moderate and mild disability, integrated settings, non formal education, open schools, open university education and other forms of distance learning would be concurrently encouraged.

## 18. Non Discrimination :-

Community as a whole would become aware of the needs and problems faced by the disabled in day to day life. This awareness would lead to measures in the transport sector, buildings and organizations, that would ensure non-discrimination against the disabled. Some such measures may would include.

- adaptation of buses and trains to permit easy access to disabled persons.
- ramps in public buildings, specially in educational institutions.
- adaptation of toilets for wheel chair users in buildings and trains.
- ramps in hospitals, primary health centres and other medical care and rehabilitation institutions.

19. **Calendar of activities**

The calendar of activities for the first Three years would in brief be as follows

| | | |
|---|---|---|
| (I) | Creation of awareness, Publicity campaign environment building | - 1 to 3 months (Coninues throughout at alittle lower pitch) |
| (ii) | Selection of Viklang-Bandhu, Hat-Bazar | 4th to 6th month level worker |
| (iii) | Training of volunters | 6th to 9th month |
| (iv) | Camps to clear of backlog in providing facititilies aids and appliances | 9th month to 18th month |
| (v) | Admission of mildly and moderately disabled to normal schools. | 9th month to 12th month |
| (Vi) | opening of special schools for each kind of disability in each district. | 9th month to 18th month |
| (Vii) | Training of teacher for IED | 9th month to 3 yrs. (On campaig basis There after on regular basis) |
| (viii) | Technical training of the disabled - | 9th month to 3 Yrs |
| (ix) | Provision of resources for self employment. | 9th month to 3 yrs. (On campaign basis to clear the back log.Then continues on regular basis). |

## 20. Financial Resource Mobilisation

The cutting edge in this project is the voluntary disability worker i.e. the Viklang Bandhu . Since the Viklang-Bandhu is working voluntarily, his training expenses only have to be met. The Hat Bazar level workers would be reimbursed the expenses that he/she would incur on items like stationery, travelling and other contingencies. The Janpad CBR organiser working at the block level would work under the Janpad Panchayat.

The Janpad CBR organizer would be a full time worker and he would have to be paid salary. His office would be in Janpad Panchayat's Office. The Medical input would be provided by the Primary Health Centre (PHC).

The main sources of funds, to meet the expenses would be -

1. **Nirashrit Nidhi** :- As per the 'State Act of 1970' an amount of 10 paise is collected out of every Rs.100/- sale of agriculture produce in the agriculture produce Market (called Mandi in Madhya Pradesh). This is a regular source of income and the amount is collected in every district by the Mandi Commiittee and deposited with the district Collector. Rules have been framed for the utilization of this amount. The rules provide for using this money for the welfare of the disabled persons of the district. This is a regular source of income and is quite substantial in most of the districts. This fund will take care of the expenses to a great extent.
2. State government provides a grant of about 1.75 crores to 65 NGO's in the State. The NGO net-work will be further strengthened and used to deliver the services in this programme.
3. The GOI provides grant to the NGOs for the purpose of education, training and rehabilitation of the disabled. Last year .....NGOs were provided a granted Rs...... . One DRC (at Bilaspur) is already being run with 100% Central Grant. The State expects sanction of another two DRCs from the GOI in the

current year. In remaining 42 districts DRCs will be opened with comparatively lesser staff, funded by the Nirashrit Nidhi.

4. The GOI or agencies like UNICEF will be approached for help to train all the voluntary workers at the village, Hat Bazar, Janpad and district level.

5. State Govt. provides for a small sum of about 25 lakhs every year for providing aids and appliances to the disabled. This would also be routed through the CBR network.

6. Confederation of Indian Industries, Federation of Indian Chambers of Commerce and Industries, Indian Red Cross Society, Industrialists, Trade Associations, Philantharists would be appealed and approached for financial assistance for the programme.

7. ZPs, Jps and GPs are getting substantial financial help now under the Tenth Finance Commission and State Finance Commission recommendations. This amount is a discretionary grant to these local bodies. The Panchayats can help financially and also by way of infrastructure and staff.

8. The Self-help group in the village which would be benefited, can contribute a small sum every month towards the honorarium to the Viklang Bandhu and the Hat Bazar level worker. However, this would be left entirely to the discretion of the community.

9. The Gram Panchayat and Janpad Panchayat may also consider paying an honorarium to the Viklang Bandhu / Hat Bazar level worker, looking to his/her services and utility to the community.

## 21. Sustainability

Sustainability here would mean continuance of the programme even without Govt support in terms of money and directives. A mechanism is to be evolved, such that the community continues to feel the need for it and fends for it through its own resources. The felt need and awareness keeps the system and programme rurrning, without it coming to an end for lack of governmental support.

Community participation is at the core of the strategy. At all levels, the feeling has to be that of voluntarism and dedication rather than self interest. Most of the govt. programmes have failed to deliver in the past, because of the dysfunctional aspects of bureaucracy, where people start creating their own empire and vested interests get deep rooted. Over a period of time, the overall objective is lost sight of, and the individuals start working for their own objectives which very often is contrary to the real objectives of the project itself. One such danger in any programme of this kind is that the bureaucracy created to alleviate the problem, starts working to make the problem permanent, because their own job will last as long as that problem lasts.

It is important, to ensure that this programme does not generate, yet another bureaucrarcy. It has therefore been proposed that as far as possible, the programme is run by the community itself, and voluntary efforts are encouraged at all levels.

Some of the dimensions which are important for the sustainability of this voluntary effort are a democratic structure, non centralised and strong leadership, concern for results and effectiveness, appropriate accounting and financial procedures, documentation and evaluation procedures and community involvement. CBR programme has to address the issue of resource mobilisation from within the communities to sustain their work.

The strategy is to promote self reliance among persons with disabilities. Improving access to Education and skill formation through technical training where ever possible, is the key to promotion of self reliance among persons with disabilities.

The Govt. system tends to become inefficient, slow to react, stifled by bureaucracy and consequently poor in quality. The NGO efforts usually have a bottom up style of management, with community participation and many innovative approaches. But the NGO's lack a wider perspective in planning, resources to sustain programmes for a long time are limited, and technical skills to take up large initiatives are usually inadequate. To date, there have been no attempt to intigrate these two different systems of management to evolve a single effective system. In this background, the "Panchayat Raj Institutions" (PRIs), which are proposed here as the lead players in this CBR model, may come out to be minimising the disadvantages and maximising the advantages of both these systems.

The Gram Sabha will select the Viklang Bandhu and if the community/self help group feels proper, they may contribute every month to pay him/her some nominal amount. Similarly, the Hat Bazar worker will be voluntary. Both these workers would be part time workers, and would be reimbursed the actual expenses incurred by them, whenever they are called for meetings/trainings and they use some stationery etc. The Janpad level CBR organiser would be a full time worker and would have to be paid initially from the project budget. After about 3 years, looking to the performance he may be retained and his services placed under the Janpad, on a contract basis.

Since, it's the community working for its own people, the programme is likely to continue, even when this project stops getting funds from outside. The Janpad Panchayat may pay some honorarium to the Janpad level worker and the expenses may be reimbursed out of the **"Nirashrit Nidhi"** that is being collected from the **"Mandis"** regularly. Each Janpad may meet the small contingency expense at the lower level, out of its own earnings. The basic feeling of voluntarism inbuilt in the system would keep it going. The district level work would be monitored by the District CBR Organiser. The DRC would be run by an NGO, who would play a lead role in running the CBR in the district. The district CBR organizer and the DRC would get all administrative support from the District Magistrate, District Health Officer, Dy. Director of Education, Dy. Director of Panchayat & Social Welfare etc. The DRC and the District CBR Organiser would work under the guidance of the sub-committee looking after social welfare work in the Zila Panchayat. The CBR Organiser and the skeletal staff at the DRC can be paid out of the "Nirashrit Nidhi" at the district level.

# PROGRAMME MATRIX

## Title: A PROGRAMME FOR TOTAL REHABILITATION OF DISABLED PERSONS

| PROJECT STRUCTURE | INDICATORS | MEASURES OF VERIFICATION | RISK FACTORS AND ASSUMPTIONS |
|---|---|---|---|
| Goal<br>Disabled persons are totally intergrated in to society and are recognised for their contribution | 1. Disabled persons are able to take part in all those activities as does a "normal" person. like education, work, marriage, parenting etc<br>2. Increasing number of disbaled persons are able to access jobs that are not "reserved" for them<br>3. Not subject to social exclusion in various socio-cultural events<br>4. Family and community owning responsibility for the rehabilitation of persons with disabilities<br>5. Decrease in incidence of abandonment of disabled children by parents<br>6. Disabled persons participating actively in decisions concerning them | 1. Survey and research studies<br>2. Collection of information from employment exchages and various departments<br>3. Research studies and information from disabled persons<br>4. Increasing incidence of self-initiated steps by the family and community<br>5. Break in stereo type roles of persons with disabilities<br>6. Less number of disabled children coming to institutions<br>7. Pressure groups and advocacy forums participating actively in policy making | **The idea and initiative of rehabilitation is initiated by the disabled persons, their family and the community**<br>**Social integration is not based on incentives**<br>**Persons with disabilities willing to take control over their lives**<br>**Methods and processes of rehabilitation will depend on community's response to the problem of disability**<br>**Capacities to undertake rehabilitative measures exist in the community and the families** |

| Objective | | | |
|---|---|---|---|
| 1. Increase in infrastructure and outreach of services | • Increase in users of services<br>• Decrease in incidence of preventable causes of disability in the community<br>• Disabled persons joining the rehabilitative stream at an early age | 1. Survey of users at different points of time<br>2. Record of spread of infrastructure and their accessibility<br>3. Epidemiological survey on disability<br>4. Survey to find out the age at which intervention was provided | **The need for infrastructure and services is based on the expressed need of the disabled persons and the community**<br>**The programme is not institutional based but is rooted in the community** |
| 2. Increase in capacities of parents to support and assist persons with disabilities | ⇒ Decrease in number of children seeking admission to special institutes<br>⇒ Most of the physical rehabilitation takes place in the family<br>⇒ Early rehabilitation of disabled persons | 5. Enrolment and waiting list of persons seeking admission to special institutes<br>6. Survey to find out the role of family members of persons with disabilities<br>7. Recording of instances of community initiated rehabilitative measures | **The strategy and the process of rehabilitation is based on capacities of local level volunteer and not on that of professionals**<br>**The government is fully committed to see the programme to its completion** |
| 3. Increase in the level of awareness in the community | ◆ Community creating social/ cultural/ political spaces for disabled persons to enable them to participate<br>◆ Barrier free construction in public places<br>◆ Community ensures disability preventive steps are taken<br>◆ Community initiates its own measures for social and economic rehabilitation of disabled persons | 8. Survey to find out whether the persons wirth disabilities are attending social-cultural events in the community<br>9. Survey to find out the number of public places which are accessible to disabled persons<br>10. Investment made to make buildings barrier free<br>11. Increase in coverage of immunisation etc in the community | **Government is able to integrate disability in its different programmes and departments.**<br>**The programme is not politically motivated in to a "hand out" scheme, but is rooted in to building capacities at all levels** |
| 4. Develop community based rehabilitation workers/ volunteers | ◊ CBR worker coming from the local community itself<br>◊ The concept and practise of CBR owned by the community<br>◊ Self-initiated interventions by the community | 12. Turnover rate of CBR volunteer<br>13. Record of instances where the community has initiated its own measures for rehabilitation<br>14. Survey of agencies working with peersons with disabilities and their work<br>15. Survey of literacy levels and employment status of persons with disabilities | **Appointment of Commissioner of Disabilities is not politically motivated, but a person with administrative and judicial experience and sensitivity towards problems of persons with disabilities is selected** |

| | | | |
|---|---|---|---|
| 5. Increased information and guidance to persons with disabilities | ● Disabled persons coming forward to form self-help groups<br>● Disabled persons getting education and trained in various vocations<br>● Persons with disabilities able to access edicational, vocational, employment and other services and facilities | 16. Record of disabled persons standing for elections<br>17. Survey of agendas of political parties to assess their priority on disability<br>18. Number of questions asked in legislative assembly on the state and status of persons with disabilities | |
| 6. Disability treated as an issue of political development of disabled persons | * Formation of pressure groups and advocacy forums by persons with disablities<br>* Disabled persons participating in elections at various levels<br>* Persons with disabilities active participants in policy making | 19. Number of casers of abuse, violence, discrimination and neglect sent to Commissioner of disabilities<br>20. Study of Annual Report of Commissioner of Disabilities | |

| Outputs | | | |
|---|---|---|---|
| 1 Adequate disability camps held in the state<br>2 District rehabilitation centres established in all the districts.<br>3 Teacher training institutes opened in the state on visually, hearing and mentally impaired, respectively<br>4 Special schools established in all the districts.<br>5 100 % coverage of total immunisation<br>6 50 % increase in safe deliveries<br>7 Only Iodine salt distributed<br>8 All children below 6 enrolled in Anganwadis<br>9 All disabled children who are integratables enrolled in formal or non-formal education system<br>10 All educable and trainable children enrolled in special schools<br>11 Viklang Bandhus trained<br>12 Hat bazaar workers trained<br>13 Master trainers trained<br>14 Training of parents in physical rehabilitation<br>15 Rehabilitation plan of disabled persons prepared<br>16 All persons with disabilties pursuing their rehabilitation plans<br>17 Communities trained on disability and the problems of disabled persons<br>18 One NGO in each district promoted to take up the cause of disabled persons<br>19 One self help group in each block promoted<br>20 Public buildings and places made barrier free | 1. Persons with disabilities are able to procure aids and equiments<br>2. Disabled persons have their identity cards<br>3. Increase in no. of trained teachers<br>4. Increase in institutional capacities<br>5. Increase in coverage of immunisation<br>6. Larger number of deliveries taking place in hospitals or under proper medical supervision<br>7. Decrease in cases of malnutrition<br>8. Increase in literacy levels of persons with disabilities<br>9. Wider range and larger number of vocational trainings received<br>10. Viklang Bandhus and Haat Bazar workers taking trainings of parents and community members<br>11. Increased no. of therapies conducted in villages & families<br>12. Increse in number of disabled beneficiaries in various development schemes<br>13. More loans distributed to persons with disabilities by banks and other lending institutions<br>14. Expenditure on modification of physical structures to make them barrier free<br>15. Increase in number of NGOs working with disabled persons<br>16. Increase in formation of disabled persons associations/ federations<br>17. Increase in agenda items on problems of disabled persons in local bodies<br>18. Increased representation to government on problems of persons with disabilities | 1. End of programme survey to find out the number of disabled persons with aid and equipment<br>2. Camp Reports<br>3. Report from Department of Social Welfare<br>4. Reports from Health Department and Department of Education<br>5. Enrollment in vocational training insitutes, like ITI's Polytechniques etc<br>6. Enrollment figures in instutes of higher education<br>7. Diaries of Viklang Bandhus and Haat Bazar worker<br>8. Survey of parenst and community to assess their attitudes on disability<br>9. Concurrent reports of various development schmes<br>10. Periodic Reorpts of banks and other lending institutions<br>11. Survey of buildings and public places<br>12. Reports of the Registrar of Firms and Societies<br>13. Report from the Department of Social welfare on recognition given to NGOs working with disabled persons<br>14. Report from panchayats and various local bodies<br>15. Complaints received by the Commissioner of Disabilities | **The government is able to mobilise resources initially and make them available in time to sustain community's motivation and momentum . Later PRGs take over this role.**<br>**Community is involved in deciding the location, timing and duration of the camp**<br>**Rehabilitation Council of India gives permission to open teacher training institutes**<br>**The convenience and availability of Viklang Bandhus and Haat Bazar Workers is taken care of while imparting training**<br>**Training is by resource persons who are ideologically and pratically committed to the concept of CBR**<br>**The training to families and community is participatory and is based on their need to know**<br>**Rehabilitation plan of persons with disabilities is prepared in consulatation with them and not imposed on them**<br>**Orientation and sensitisation of offcials who will be coming in contact with disabled persons, eg, banks, teachers etc**<br>**Commissioner of Disabilities is open and accessible to all** |

| Inputs | | | |
|---|---|---|---|
| 1. *Orientation and training of district* level officials on Camps for persons with disabilities<br>2. Orientation of officials on participation of community in the programme<br>3. Training of Master trainers<br>4. Training of Viklang Bandhus and Hat Bazar workes<br>5. Ngos oriented towards the programme objectives and their cooperation solicited<br>6. Proposals from ngos for opening of teacher training institutes and district rehabilitation centres<br>7. Parents trained in various aspects of physical rehabilitation<br>8. Counselling of parents and disabled persons on social and ecnomic rehabilitation<br>9. Training of members of local bodies and prominent members of the community on problems of disabled persons<br>10. Media oriented to build a publicity & awareness campaign on the programme and disability<br>11. Incentives for disabled persons to join educational & vocational streams<br>12. Modifications in the examination & testing patterns of educational and training institutes to suit the needs of the disabled persons<br>13. Concessions and incentives to disabled persons in allotment of places of trade and production<br>14 Reserved jobs in government to be fulfilled | 1. Master trainers imparting training to Viklang Bandhu and Haat Bazar workers<br>2. Increase in number of cases of loans etc being santioned by officials<br>3. Disabled persons being given assistance under schemes that are more relevant to them<br>4. Parents support groups formed<br>5. Parents taking increasing interest in the rehabilitation of their children<br>6. Therapies and activities of daily living being imparted by parents to their children<br>7. Members of the community making suggestions and taking initiative in creating a barrier free environment & putting up agenda items for discussions in local bodies<br>8. Increase in number of news items in media<br>9. Positive role models projected by the media<br>10. The number of beneficiaries under the incentive schemes increased<br>11. Larger number of disabled persons passing the examination<br>12. More disabled persons chosing self employment<br>13. Disabled persons venturing in to new and untried vocational fields | 1. Report of trainers at various levels<br>2. Evaluation of training programmes<br>3. Reports of departments at the district level<br>4. Survey to find out the roles and responsibilities of family members of persons with disabilities<br>5. Reports of ngos and disabled persons associations<br>6. Rehabilitation plans of disabled persons<br>7. Survey in the community to assess their attitudes and myths prevalent in them on disability<br>8. Media moitoring<br>9. Employment and economic status survey of persons with disabilities | **Rigorous monitoring of the follow up of training**<br>**The time lag between sanction of proposal and availability of resources should be minimal**<br>**There should be a genuine and sincere attempt at integrating disabled persons in educational and vocational stream and not a mere tokenism**<br>**Counsellors are not prescriptive but facilitative in nature**<br>**Aids and equipments can be procured and repaired locally**<br>**Disabled persons and their care providers are familiar with the use of aid and equipment**<br>**Reporting in media balanced and consistent**<br>**Problems of parents are also solved which go beyond the field of disability**<br>**Proper coordination and integration at the district level departments** |

# SUSTAINABILITY ANALYSIS

## Of the Idea

The programme does not propose a structured scheme or a project which has to be implemented with all nuts and bolts intact. Instead the programme is more focussed on creating the right kind of facilitative environment so that intended outputs may emerge. The emphasis is on processes and not on products. Hence the picture of rehabilitation may be different in different villages depending on local situations and resources. The processes in terms of inputs will be more or less the same: capacity building at the local level; orientation and sensitisation of officials; availability of para- and professionals as and when required.

The idea of total rehabilitation, of what it means, how can it be achieved and what is that the community can do about it will emerge from the community itself. After the programme period even if the inputs are withdrawn the community will be able to respond to the changed situation and make modifications in its rehabilitative plan.

The programme seeks to involve all the stakeholders. This will allow different points of view to be discussed with the community itself and allow them to take decisions accordingly. Strategically this will take care of self interest of stakeholders as well as find the middle path of rehabilitation which will not antagonise any one stakeholder group.

## Of the Impact

The intended impact of the programme is to bring about total rehabilitation of the persons with disabilities. It may be possible within the programme period to achieve this with the current number of disabled persons. The real impact will be with persons who will join this group (of disabled persons) after the programmne period.

If the programme workers, namely Viklang Bandhus, Haat Bazar workers and government functionaries are successful in establishing the community ownership of the aims and objectives then it may not be difficult to make the impacts sustainable. Since the capacity is being build at the local level of local persopns within the community they can be called upon to intervene at an early stage.

The programme is not instituional based where the outreach and the capacity of the institute is limited by its resources. The programme is community and target group based, where capacities for rehabilitation are built in to members of the community and disabled persons who can come forward and provide assistance and support on their own..

## Of Resources

The programme in the very beginning will train the community to distinguish between: what is that they can do on their own?; what is that they can do with a little bit of help from other?; and what is that they cannot do?

Funds and other resources that will be required by the community in response to the latter two will be provided even after the programme period by the PRIs and Nirashrit Nidhi though the method of such assistance will change once the programme is over.

## Proposed Expenditure on Various items for five year

### A FIRST YEAR

| S.No. | Details of Schemes | Recurring Expenditure | Non-recurring Expenditure | Total |
|---|---|---|---|---|
| 1 | State Institute on Disability Disability Rehabilitation | This Scheme is proposed to be funded by GOI | | |
| 2 | District Resource Centre in 42 districts. | | | |
| | **Non-Recuring Expenditure** @ Rs.7,00,000/- | 2,48,34600 | 2,94,00,000 | 5,42,34,600<br>(Say 5,42,35,000) |
| | Recuring Expenditure @ Rs.5,91,300/- | | | |
| 3 | Janpad level staff Janpad Disabled Welfare Organiser for 459 Janpad Panchayat @ Rs.4000/- P.M. | 34,42,500/- | - | 34,42,500/-<br>(Say 34,43,000) |
| 4 | Confingencies to Hat Bazar worker @ Rs. 2400/- per Year for 7000 workers . | 1,68,00,000 | - | 1,68,00,000 |
| 5 | **Training Expenses** at State Head Quarter for 3 days for 270 persons (6 persons from each district | | | |
| | A- 1 Boarding Expenses @ Rs.50/- per day. | - | 40,500 | |
| | A-2 Training material Rs.50/- | - | 13,500/- | 64,000 |
| | A-3 Honourarium to Guest faculty | | 10,000/- | |

| | | | | | |
|---|---|---|---|---|---|
| 6. | Trainers Training at District level for 7 days, 6 persons from each Janpad Panchayat 459x6 = 2754 persons. | | | | |
| 6.1 | Boarding Charges @ Rs.30/- per day. | - | 5,78,340 | 5,78,340 | |
| 6.2 | Training material @ Rs.50/- per trainee. | - | 1,37,700 | 1,37,700 | |
| 6.3 | Other Contingency Expenses Rs.1000/- per district. | - | 45,000 | 45,000 | (7,61,040)<br>(Say 7,60,000) |
| 7. | Training of Hat Bazar Worker Viklang Bandhus at Janpad Panchayat head-quarter at 459 blocks. | | | | |
| 7.1 | Boarding Expenses @ Rs.30/- per day per person - for 77,000 persons for 14 days. | - | 3,23,40,000 | 3,23,40,000 | |
| 7.2 | Training material @ Rs.50/- per person. | - | 38,50,000 | 38,50,000 | |
| 7.3 | Travelling Expenses @ Rs.30/- per person. | - | 23,10,000 | 23,10,000 | |
| 7.4 | Other Contingencies @ Rs.1000/- per Janpad | - | 4,59,000 | 4,59,000 | 3,89,59,000 |
| | TOTAL | | | **9,74,61,000** | |

## B. Total expenditure for the subsequent 4 years (from second to fifth year)

| | | |
|---|---|---|
| 1. | DRC in 42 distts. @ 5,91,200/-per DRC per per year, | 9,93,00,000 (app) |
| 2. | Janpad disabled welfare Organiser for 459 Janpads @ 4000 per month | 1,37,70,000 |
| 3. | Contingencies to the 7000 Hat Bazar workers @ 2400 per year. | 6,72,00,000 |
| 4. | Training at state level (same as in item 5 for first year) | 2,56,000 |
| 5. | Training at district Hq. (same as in item 6 for first year but for 3 days each year) | 12,00,000 (app) |
| 6. | Training at Block Hq. (same as in item 7 for first year, but for 7 days each year). | 7,00,00,000 (app) |
| | | Rs. 25,17,28,000<br>( Rs. 25 crores app.) |

# District Resource Centre

1. Set up of staff (Recurring expenditure)

| S.No. | Perticulars of Post | Pay scale | No.of post | One month salary |
|---|---|---|---|---|
| 1. | District coordinator C.B.R. Programme. | Rs.5000/- | 1 | 5000-00 |
| 2. | Physiotherapist | 1400-2340 | 1 | 4200 |
| 3. | Occupational therapist | 1400-2340 | 1 | 4200 |
| 4. | Speech therapist Expert | 1400-2340 | 1 | 4200 |
| 5. | Orthotist/Prosthetist | 1400-2340 | 1 | 4200 |
| 6. | Cobler/Carpenter/ Technician / Peon. | 750-945 | 4 | 10,000 |
| 7. | Driver | 950-1530 | 1 | 3500 |
| 8. | Accountant | 1240-2040 | 1 | 4000 |
| 9. | Other contengencies / POL | | | 10,000 |
| | | | Total | Rs.49,300/- |

Rs. 49,300 x 12 month = 5,91,600/-

**Non-recurring**

| | | |
|---|---|---|
| 1. | Physio - Occupational Therapy Equipments | 1,25,000 |
| 2. | Speech therapy / Audiology | 75,000 |
| 3. | Orthotic / Prosthetic Workshop | 1,00,000 |
| 4. | Furniture Equipment for Administrative Wing | 50,000 |
| 5. | Vehicle (One) | 3,50,000 |
| | Total | 7,00,000 |

# Programme on Energy, Environment, Resources, and Sustainability (PEERS) - 1997/98

## Final Project Report

# Basic needs of rural people & a sustainable land use in forestry sectors: a case study in Bangladesh

*Submitted by*
**Mr Md Faruque Hossain**

April 1998

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# BASIC NEEDS OF RURAL PEOPLE AND A SUSTAINABLE LAND USE IN FORESTRY SECTORS: A CASE STUDY IN BANGLADESH.

MD FARUQUE HOSSAIN
DIVISIONAL FOREST OFFICER
MYMENSINGH FOREST DIVISION

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NEW DELHI, INDIA.

APRIL 1998

# Table of Contents

I. Acknowledgement

II. Abstract

**Chapter - 1**

1. Introduction
    - 1.1 Introduction to Bangladesh .......... 1
    - 1.2 Land-use Systems
        - 1.2.1 Agriculture .......... 3
        - 1.2.2 Forestry .......... 3

**Chapter - 2**

2. Literature Review .......... 8
    - 2.1 Land-use practice in the forestry sector .......... 8
        - 2.1.1. Sustainable development .......... 8
        - 2.1.2. Forest management .......... 8
        - 2.1.3. Agroforestry as a management practice .......... 9
        - 2.1.4. Agroforestry practices in Bangladesh .......... 10
            - 2.1.4.1 Homestead agroforestry .......... 10
            - 2.1.4.2 Cropland agroforestry .......... 11
            - 2.1.4.3 Traditional agroforestry in hilly areas .......... 12
            - 2.1.4.4 Agroforestry for the rehabilitation of degraded and encroached plan land sal forest .......... 14

**Chapter - 3**

3. Description of the study area .......... 19
    - 3.1 Location .......... 19
    - 3.2 Climate .......... 19
    - 3.3 Land and soil .......... 21
    - 3.4 Land use in Mymensingh forest division .......... 22

**Chapter - 4**

4. Study Objectives .......... 36

**Chapter - 5**

5. Methodology . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 37
  5.1 Method of data collection . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 37
  5.2 Study areas and sample interviews . . . . . . . . . . . . . . . . . . . . . . . . 37
  5.3 Study findings . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 38
    5.3.1 Environmental and tree issues . . . . . . . . . . . . . . . . . . . . . . 38
    5.3.2 Beneficiary of forest department . . . . . . . . . . . . . . . . . . . . 38
    5.3.3 Homestead areas . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 38
    5.3.4 Land ownership . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 39
    5.3.5 Income position . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 39
    5.3.6 Interest in land use practices (Agroforesty, Woodlot) . . . . . . . . . . . . . . . . . . . . . . . . . 40

**Chapter - 6**

6. Discussion and Recommendation . . . . . . . . . . . . . . . . . . . . . . . . . . . 41
  6.1 Homestead agroforestry . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 41
  6.2 Cropland agroforestry . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 42
  6.3 Agroforestry for the rehabilitation of the degraded Sal forest . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 42
  6.4 Roadside agroforestry . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 43

**Chapter - 7**

7. Conclusion . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 44

**Chapter - 8**

8. Appendices 45

**Chapter - 9**

9. References . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 52

# List of Tables

Table 1. Showing the growing stock and annual consumption of forest products . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5

Table 2. Pre and post settlement annual income of settlers . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 14

Table 3. Income of Agroforestry and others . . . . . . . . . . . . . . . . . . . . . . . 15

Table 4. Trend of paddy reduction in Dinajpur forest division . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 16

Table 5. Income for pineapple cultivation . . . . . . . . . . . . . . . . . . . . . . . . 17

Table 6. Income from ginger cultivation . . . . . . . . . . . . . . . . . . . . . . . . . 17

Table 7. Wood production in agroforestry farm in Dinajpur . . . . . . . . . . . . 17

Table 8. Outurn from Agriculture and wood sources . . . . . . . . . . . . . . . . 18

Table 9. Population of Mymensingh Division . . . . . . . . . . . . . . . . . . . . . . . 19

Table 9A. Socio economic profile of Mymensingh forest division . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 22

Table 10. Area statement of Mymensingh forest division . . . . . . . . . . . . . . 23

Table 11. District wise wood lot and agroforestry plantation . . . . . . . . . . . . 23

Table 12. District wise bamboo, cane and murta plantation . . . . . . . . . . . . 28

Table 13. District wise strip and institution plantation . . . . . . . . . . . . . . . . . 28

Table 14. Interviewed persons knowing about environment and benefit of tree . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 38

Table 15. Beneficiary of forest department . . . . . . . . . . . . . . . . . . . . . . . . . 38

Table 16. District and range wise status of homestead area . . . . . . . . . . . 39

Table 17. District and range wise status of land ownership . . . . . . . . . . . . 39

Table 18. Income position of the interviewed persons . . . . . . . . . . . . . . . . 40

Table 19. Persons interested in Agroforestry and wood lot plantation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 40

## List of Appendix

Appendix 1. List of field crops suitable for the study area . . . . . . . . . . . . . . . 45

Appendix 2. District wise name of Thanas and ranges . . . . . . . . . . . . . . . . . 47

Appendix 3A.List of interviewed persons (District) . . . . . . . . . . . . . . . . . . . . . 48

Appendix 3B.List of interviewed persons (Range) . . . . . . . . . . . . . . . . . . . . . 48

Appendix 4. Questionnaire . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 49

Appendix 5. Organisation working in agroforestry research, development and extension in Bangladesh . . . . . . . . . . . . . . . . 54

Silvicultural characteristics of tree species . . . . . . . . . . . . . . . . . 54

## List of Figures

Fig. 1. Map of Bangladesh . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2

Fig. 2. Distribution of forest land in Bangladesh . . . . . . . . . . . . . . . . . . 4

Fig. 3. Forest area by annual production and consumption . . . . . . . . . . . 6

Fig. 4. Map of Mymensingh Division . . . . . . . . . . . . . . . . . . . . . . . . . 20

Fig. 5. Agroforestry in Rasulpur Range . . . . . . . . . . . . . . . . . . . . . . . . 24

Fig. 6. Woodlot plantation in Rasulpur range . . . . . . . . . . . . . . . . . . . 27

Fig. 7. Strip plantation in Study Area . . . . . . . . . . . . . . . . . . . . . . . . . 30

Fig. 8. Homestead in Agroforestry plot . . . . . . . . . . . . . . . . . . . . . . . 31

Fig. 9. A typical homestead in woodlot plantation . . . . . . . . . . . . . . . . 31

Fig. 10. Pineapple transportation in study area . . . . . . . . . . . . . . . . . . . 32

Fig. 11. Jackfruits marketing in agroforestry area . . . . . . . . . . . . . . . . . 34

Fig. 12. Institution plantation in Mymensingh . . . . . . . . . . . . . . . . . . . 35

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# ABSTRACT

Bangladesh is the most densely populated country in the world, with an estimated density of 755 persons per Sq. Km. Agriculture is the mainstay of the economy and more than 86% people live in rural areas. Per-capita cultivable and forestland is one of the lowest in the world. As a result there exists little scope for horizontal expansion of agriculture and forestry. There is an immediate need for innovative and intensive and sustainable land use for maximizing output and income from limited land resources. Agroforestry and wood lot plantation considered to be a very important tool for maximizing out put by integrating Crops, trees and animals.

There exist some traditional agroforestry practices in different zones of Mymensingh. There are homestead agroforestry, cropland agroforestry, road- side agroforestry etc. Beside this some site-specific practices like pineapple based practice, betel leaf based practice also exists. The systems are quite productive and well adapted with the Eco-social condition of the area. More over, government has initiated some rehabilitation programmes in participation of local land-less people. They are also quite promising and play significant role for alleviating rural poverty.

Agroforestry practices are in active stage of development in the study area. Among the different agroforestry practices and technology so far tried in the country alley cropping for rehabilitating degraded plain land Sal forest and silvihorticultural practices for degraded Sal forest to make it Sustainable forest have gained popularity among the land less people and encroachers.

The study examine and evaluate the problems and constrains of the existing traditional practices as well as give guide lines for sustainable land use in the study area.

# CHAPTER-1

## INTRODUCTION

## 1.1 An Introduction to Bangladesh

### Geographical Location, Extent and Population

### Geographical Location and Area

Bangladesh is located in South Asia and covers an area of 147, 570 sq. km. The Tropic of Cancer passes through Bangladesh and the country lies between $20^0$34 and $26^0$38 north latitude and $88^0$01 and $92^0$41 east longitude (Anon, 1993).

Bangladesh is bordered by India in the west and north, by India and Mayanmar in the east and by the Bay of Bengal in the south (Fig-1.).

### Population

Bangladesh is the most densely populated country in the world. According to the 1990 census total population of the country is about 111.4 million with an estimated density of about 755 persons per km. Annual rate of population growth is about 2.17% (Anon, 1991). The economy of the country is primarily agrarian and 86% of the people lives in the rural areas.

### Biophysical Environment

### Climate:

Bangladesh is dominated by tropical monsoon climate. Major climatic difference can be recognized by the amount of rainfall received annually.

**Rainfall:** The average rainfall is about 166.67 mm per month Highest rainfall experienced in the north eastern part of the country and which is about 383.33 mm. at sylhet. In Mymensingh it is about 132.69 mm and highest is in the month of August and is about 361.10 mm.

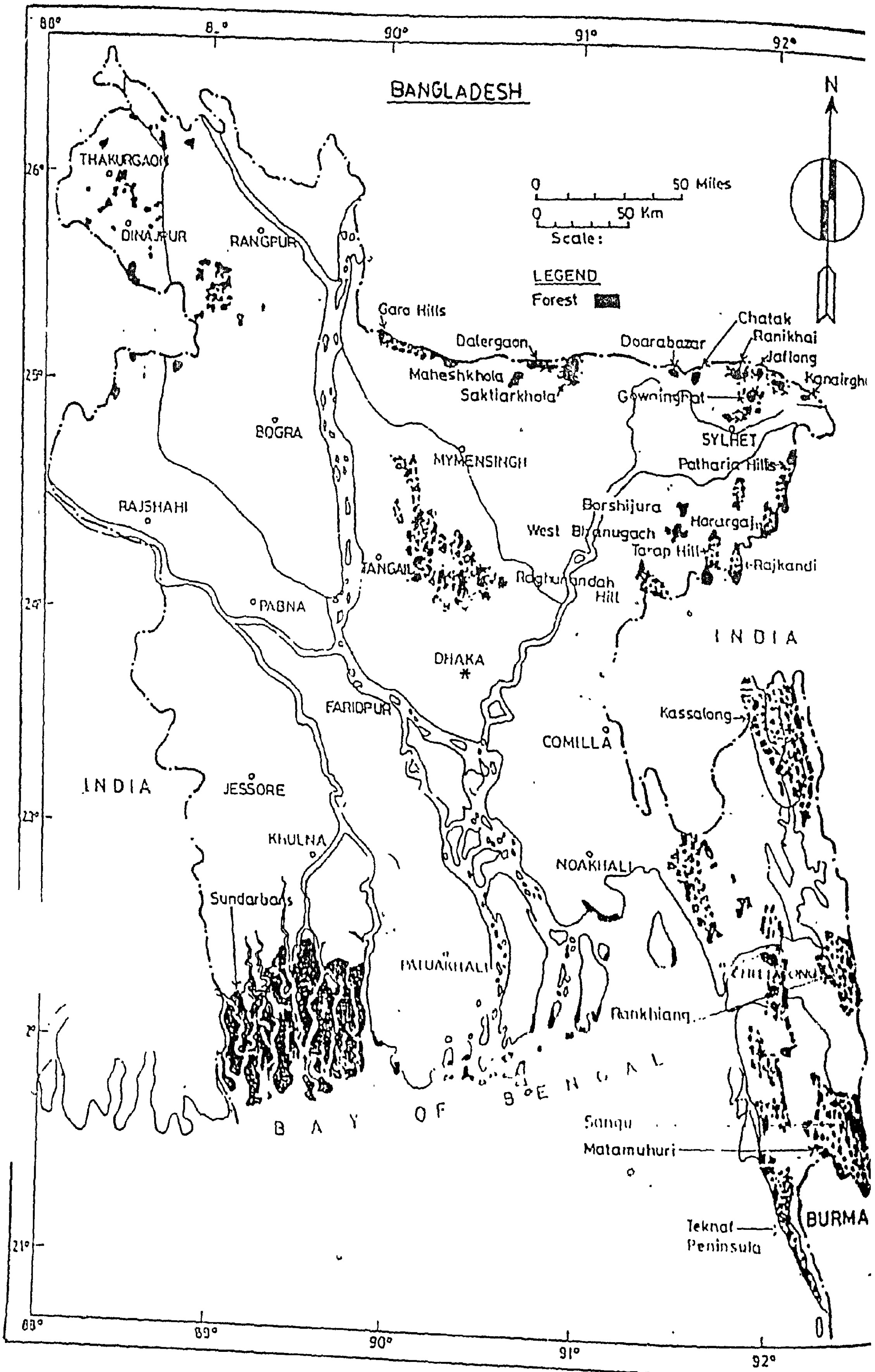

BANGLADESH
N
0 50 Miles
0 50 Km
Scale:
LEGEND
Forest
88°
89°
90°
91°
92°
26°
25°
24°
23°
22°
21°
THAKURGAON
DINAJPUR
RANGPUR
BOGRA
RAJSHAHI
PABNA
TANGAIL
MYMENSINGH
DHAKA
FARIDPUR
JESSORE
KHULNA
Sundarbans
PATUAKHALI
NOAKHALI
COMILLA
SYLHET
CHITTAGONG
INDIA
INDIA
BURMA
BAY OF BENGAL
Garo Hills
Dalergaon
Maheshkhola
Saktiarkhola
Doarabazar
Chatak
Ranikhai
Jaflong
Kanairghat
Gowainghat
Patharia Hills
Borshijura
West Bhanugach
Harargaj
Tarap Hill
Rajkandi
Raghunandah Hill
Kassalong
Rankhiang
Sangu
Matamuhuri
Teknaf Peninsula

Fig- 1

**Temperature:** The average temperature is about $25.6^0$c. It ranges from $5^0$c to $42^0$c. In the plain frost are unknown, but the exposed part of the northern and eastern hills occasionally experience light frost.

**Topography:** About 80% of the country consists of deltaic flood plain sediments, with hills and raised terraces constituting the remaining 20% of the area. The flood plain is formed by the confluence of the mightiest river system the Ganges- Barhamaputra–Meghna river system. These areas are subjected annual flooding and are recipients of alluvial deposits. The raised terraces cover mainly Bhawal-Madhupur and Barind tracts falling in the greater districts of Dhaka, Mymensingh, Tangail, Comilla, Rangpur, Dinajpur, and Rajshahi. The hills are situated in the northern and eastern part of the country.

**Geology and Soil:** Geologically Bangladesh may be categorized by three major formations e.g. Recent Alluvium, Madhupur clay, Tertiary Hill Sediments

## 1.2. Land use systems

### 1.2.1 Agriculture:

Bangladesh's economy and employment are dominated by agriculture. Area under agriculture is about 8.25 million hectares, which is about 55% of the total land area of the country. The Agriculture sector accounts for about 55% of the total land area of the country. The agriculture sector accounts for about 33.5% of G.D.P (1992-93) and 68.1% (1990) of the employment opportunities (Anon, 1993). Almost all the people who live in rural areas are engaged some way in agriculture.

### 1.2.2. Forestry:

Bangladesh has only 2.465 million ha of forest, which is about 16.73% of the total land area of the country. The total state owned forest is about 2.195 m. ha of which 1.965m. ha area that is 67% are controlled and managed by the forest department and the remaining 0.73-m ha is Unclassed state forest under the control of local district administration. Beside the state owned forests about 0.27 m ha are privately owned village forests scattered all over the country (Fig- 2).

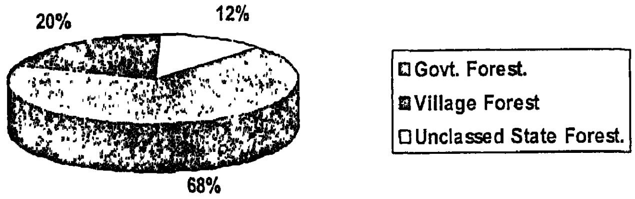


Fig: - 2. Distribution of Forest land in Bangladesh.

## Forest Types :

Depending on the location and nature, forests can be grouped into following categories: (Fig–3)

**Tropical Evergreen and Semi-Evergreen forests:** It is accounts for about 1.4 m. ha (including 0.73% m ha of USF land ) and are located in the eastern and north –eastern hilly regions of the country. The forests are classes as multistoried high forests, the main species are Dipterocarpus spp, Swintonia floribunda, Lagerstroemia flosraginaea, Eugenia jambolena, Hopea odorata, Gmelina arborea, Artocarpus chaplasha , Mesua ferra , Michelia chanpaca etc. Bamboo occurs abundantly as understory (Ghani 1957)

**Tropical Deciduous Forests:** The moist/dry deciduous forests also formed as In land sal forests located in central and northern part of the country. Total area covered by this type is about 0.12 m ha. The most dominant species is Shorea robusta. The other species are Adina cordifolia, Dillenia pentagyna, and Streblus asper.

**Mangrove Forests:** The Tidal forests or mangrove forests of Bangladesh commonly known as Sunderbans cover an area of 0.57 m ha. This is the forest formation in acid sulfate soils of the deltaic region in the south- western part of the country bordering the Bay of Bengal. The main species are Sundori: Heritiera fomes, Gewa: Excoecaria agallocha, Goran: Ceriops roxburghiana, Keora: Sonneratia apetala, Baen: Avicennia alba, Golpata: Nipa fruticans .

In addition to the main mangrove formations about 0.115 m ha. of coastal plantation have been raised to stabilize the newly accreted land and to protect the nearby communities from cyclone and tidal surges. So total mangrove forests now accounts about 0.675 m ha.

**Village Forest:** This category includes tress growing mostly on homestead land and around dwelling houses in the rural areas The village forests constitute about 0.27 m. ha. Crown covers area.

## Growing Stock, Annual Production and Consumption: -

The forests of Bangladesh have 100.18-m. cubic meters of growing stock. Out of that village forests accounts for about 54.7 million ($m^3$). And government forests have 45.88 million cu. m. ($m^3$) (Anon 1991).

**Table – 1 Showing the growing stock, and annual consumption of forest product.**

| Category | Area (million ha) | % | Growing stock (million cu m) | % | Annual consumption | % |
|---|---|---|---|---|---|---|
| Government forest | 2.195 | 89 | 45.48 | 45 | 1.3 | 13.5 |
| Village forests | 0.27 | 11 | 54.7 | 55 | 8.3 | 86.5 |

Govt. and Village forest by consumption.

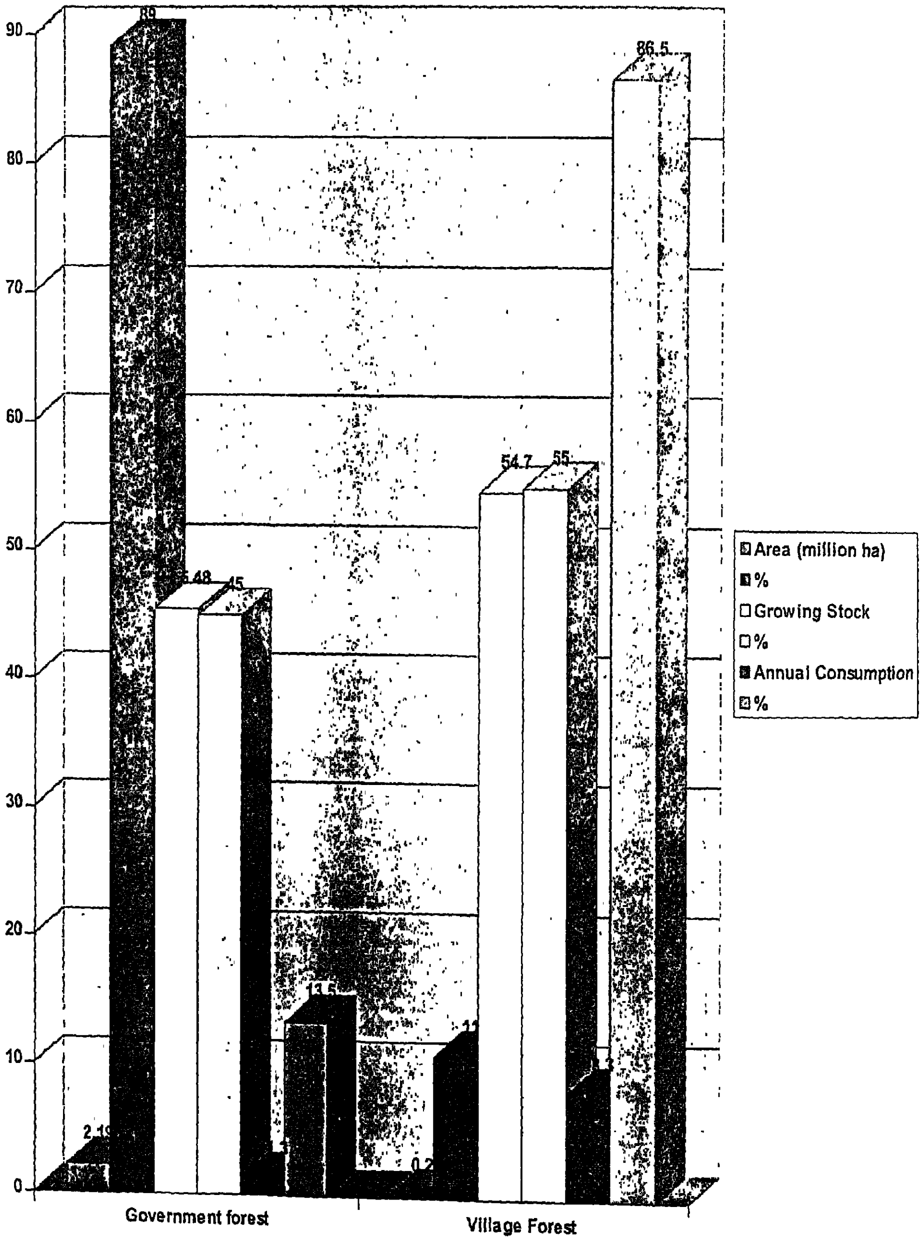


Fig 3. – Forest area by annual production and consumption

As shown in Table-1 and Fig-3 government forests, which account about 89% of the growing stock and produced 14% of the wood consumed annually. On the contrary village forests which accounts about 11% of the total forest land have 55% of the total growing stock and fulfil 86% of the total consumption of the country.

The basic need of the people (i.e. Food, Cloth,& Shelter etc.) comes from land. Land directly or in directly provides us the Food, Cloth and Shelter in the rural areas. Peoples in the rural area of Bangladesh depends on land resources to meet their basic needs. Due to continuos and misuse of the limited land resources, it loses its fertility and productivity. To keep the land fertile and productive in sustained which persists or survives to meet the needs of the present without compromising the ability of future generations to meet their own needs a sustainable land use system must be developed in the country as well as in the forestry sector

# CHAPTER-2

## 2. LITERATURE REVIEW

### 2.1. Land uses Practice in the forestry sector.

#### 2.1.1. Sustainable Development:

The World Commission on Environment and Development defined sustainable development as "development or progress that needs of the Present without compromising the ability of future generations to meet their own needs."(WCED)

#### 2.1.2 Forest Management.

In the past, government owned forests were managed to maximize production and revenue earning. Sufficient attention was not given on the conservation of ecosystem and socio-economic consideration of the people adjacent to the forests. The Management systems for different types of forests were as follows –

1. Tropical evergreen and Semi evergreen forests- Clearfelling followed by artificial regeneration (by commercially important species).
2. Tropical deciduous Forests – Coppice selection system.
3. Mangrove Forests – Selection cum – Improvement felling system.

Bangladesh have about 16.73 percent of forestland. This has made the country as a whole ecologically critical. The situation of Northern Bangladesh, having very few forestlands (0.3 percent forest cover) is still alarming.

About 0.73 million ha (5% of the total land area) of Unclased state forestland under control of District administration is virtually without any tree cover. Bangladesh has only 6.5% percent area under actual tree cover, and the situation would be aggravated further in future

(Anion, 1991)

Pursuance of traditional approach to forest management and protection of forests without local people's involvement proved counter productive and also resulted in frequent direct confrontation with local people. Consequently, there is progressive degradation of forest through depletion of tree cover and loss of forestland due to encroachment (Bhuiyan, 1994). There-fore, from the above realization and to arrest further deterioration, a moratorium on all forest felling in the government forests up to 2000 AD has been introduced.

### 2.1.3. Agroforestry as a Management Practice:

Agroforestry, an age-old practice has received attention in recent years. That is to say agroforestry is a new name to a set of old practices (Nair, 1989).

Agro-forestry is a sustainable management system for land that increases overall production, combines agricultural crops, tree crops and forest plants and/ or animals simultaneously or sequentially, and applies management practices that are compatible with the cultural patterns of the local population (Bene et al, 1977).

Agro-forestry is a land use system that involves people socially and ecologically acceptable integration of trees with agricultural crops and or animals simultaneously or sequentially, so as to get increased productivity of plant and animal in a sustainable manner from a unit of farm land, especially under conditions of low level of technological inputs and marginal lands (Nair, 1989).

In short, agro-forestry is a land use system. It maximizes production and it would be sustainable both ecologically and economically. Moreover it should be compatible with social and cultural practices of local people.

**Attributes of Agro-forestry: –**

1. The land management system is sustainable, because more yields expected

from different combination of crops, such as food, fodder, timber, fuel wood and animal crops, either simultaneously or sequentially. There exists no gap in supplying goods and services, failure of one crop will be supplemented by other- (Zabala, 1990)

ii) The system is consistent with sound ecological principles. It ensures the biological productivity and renewable capacity of the soil, through nutrient re-cycling; improvement of soil fertility and amelioration of the microclimate.

iii) The systems contribute to the Socio-economic upliftment of the community through creating income and employment opportunities from different goods and services provided by the system.

iv) The system is compatible with the cultural practices of the local people.

### 2.1.4. Agroforestry Practices In Bangladesh

Agro-forestry practices are not new in Bangladesh, it is a new name to a set of old practices.

**Agro-forestry Practices –**

#### 2.1.4.1 Homestead Agro-forestry-

In Bangladesh, Homestead Agro-forestry is the most highly productive and successful form of Agro-forestry practice and fulfils 86% of the total requirement of the country. Traditionally, people grows trees, fruit trees, herbs, shrubs, and vegetables as a mixed crop in the homestead around the ponds and house backyard to provide food to the family, meet petty cash requirements, provide construction material, to meet demand of agricultural implements etc,

### Peoples objectives and preferences for growing trees

Villagers prefer multipurpose trees. The most prevalent species in the homestead were betel-nut followed by coconut, jack fruit, mango, date palms, banana, bamboo and guava

(Chowdhury et.al 1993) (Appendix-1)

### 2.1.4.2. Cropland Agroforesty

Bangladesh has about 8.16 million ha. of cultivable land (Anon. 1993) of which about 29% is situated above normal flood level (FAO, 1991). The main agricultural crops cultivated on high flood plain ridges are upland rice and jute followed by Rabi crops like pulses, oil seeds and wheat. Among the cash crops sugarcane, cotton, potato, turmeric, onion, banana and a variety vegetables.

Trees are grows on fields with agri-crops forming an undestroyed, planting pattern of trees or shrubs may be dispersed widely with systematic spacing or they may be scattered at random.

**Reason for growing trees-**

Farmer prefer to grow trees in crop fields because they grow better in crop in field in comparison to homesteads. Moreover major reasons are -

— to get diversified products
— to increase the total output of mixed products
— to get fruits
— to get timber and firewood
— as an asset savings for their children
— As an insurance against risk of crop failure.

**Cropping Pattern**

Some innovative farmers developed some good agroforestry systems on their farmland. Farmers plant fruit trees or multipurpose trees on their farm bounders or randomly in the crop-fields.

**Some of the commonest practices are mentioned below-**

i. Date palm (Phoenix sylvestris) and Palmyra palm (Borassus flabellifera) based practice: In this practice, date palm and palmyra palm are planted along farm boundaries as well as in the field. Main products from the trees are juice, while leaves are used for making traditional mat and hand fan. The stem of palmyra palm is used for making canoes and provides good construction timbers.

**ii.** Mango (Mangifera indica) and Jackfruit (Artocarpus heterophyllus) based Silvi-horticultural practice- This practice is very common in west and northwestern (mango based) and central (Jackfruit based) past of the country. Mango or Jackfruit trees are planted along farm boundaries or in the crop field.

Orchard like plantation are also very common. The cropping patterns may be tree-agri crop or tree-pineapple or tree-shrub (guava)-pineapple. The main products are fruits fodder and timber from tree crops and fruits and agri-crops.

**iii.** Babla (Acacia nilotica) and Sissoo (Dalbergia sisso) based practice-
In this practice Acacia and sissoo trees are planted mostly in the cropfields. This Practice is very common in western and northern part of the country.

### 2.1.4.3. Traditional Agroforestry in Hilly Areas

**i. Taungya system -** Taungya system of hill farming was first introduced in Myanmar (Burma). It was adopted in Bangladesh at Kapti (CHTS) in the early 1870. When teak plantation were started in Bangladesh. In Burmese the term "taung" means hill and "ya" means cultivation. So "taungya" means hill cultivation.

In this practice agri-crops are grown along with the tree crops. Associated agri-crops are paddy, maize, cassava, cotton, pigeon pen, melon, cucumber, Chilies, cotton etc.

In this system clearing the area, then burning the area, planting and after care is done by beneficiary farmers in return they are paid (for jungle cutting, planting and weeding) and given a piece of farm land for growing crops.

#### ii. Jhoom Cultivation (Shifting Cultivation)

Shifting cultivation, commonly known round the globe as bush fallow or slash and burn agriculture is locally called Jhoom cultivation. This is the most primitive agriculture that mankind practiced from time immemorial, and still is practiced in Bangladesh by the tribal peoples in forested areas of Chittagong Hill Tracts.

### iii. Pineapple- based Agroforestry

Garo, a tribal community in Madhupur forest under greater Mymensingh district and the local villagers have developed a market oriented production system, where the main crop, pineapple is grown in association with ginger, aroid and other annual crops under Sal (Shorea robusta) Jackfruit & other trees.

This system provides short-term agri-crop production, mid term pineapple production and long term fruit and timber production. It enhances creation of employment opportunities of income generation.

### Copping pattern

| Main crop | Tree crops | Agricultural crops |
|---|---|---|
| Pine apple | Sal, Jackfruit, mango | mustard , cassava, papaya, |
|  | Teak, Elaeocarpus floribunda | Ginger, turmeric, banana, pigeonpea, bringal etc. |

### iv. Betagi - Pomona Agroforestry Model

In the Betagi-Pomora area of Raungunia Thana under Chittagong district, community forestry project was undertaken in 1979. With 70 families of Betagi village the programme was started, than it was extended in pomara village on khas and protected forestland.

**The objections of the project were to:**

— greening the denuded hill with the active participation of local landless people.

— Develop a sustainable agroforestry technically for hilly areas,

— Improve the Socio-economic conditions of local landless people through generating income and employment opportunities

The project was based on participatory principle and focuses on a socially acceptable economically viable and environmentally suitable hill farming approach.

### 2.1.4.4 Agroforestry for the Rehabilitation of Degraded and Encroached plain land Sal forests.

The Sal (Shorea robusta) forests of Bangladesh are situated in two different regions the central region and northwestern region of the country.

The total area of sal forest is 0.12 million ha. but they seldom appear in large compact block. Most of them consists of small patches in high lands, locally knows as Chalas intercepted by numerous depressions called 'Baid'. The Baid lands are generally cultivated with paddy.

**Income:**

In accordance to the survey data post settlement annual income is about Tk.41762.00 and which was only Tk. 15576.00 in the presettlement stage. (Table-2)

**Table-2: Pre and post settlement annual income of settlers (in Tk).**

| Villages | Pre-settlement | Post -settlement | Increase |
|---|---|---|---|
| Betagi | 14040.0 | 55404.0 | 395% |
| Pomora | 16476.0 | 33768.0 | 205% |
| Both Villages | 15576.0 | 41762.0 | |

The rate of increase was quite attractive and which was about 268% in on average.

Income from Agroforestry crops: Agroforesty activities have been generating significant income for the settlers who are about Tk.41455.0 per family. So share of agroforestry accounts about 74% of their total income (table-3)

### Table-3 Income from Agroforestry and others.

| Practices | Betagi | Percentage | Pomora | Percentage | Both | Percentage |
|---|---|---|---|---|---|---|
| Agroforestry | 42036.0 | 76% | 24016.8 | 72% | 30678.0 | 74% |
| Others | 13225.2 | 24% | 9342.0 | 28% | 10777.5 | 26% |
| Total | 55261.1 |  | 33358.8 |  | 41455.5 |  |

Expenditure against agroforestry practices was only about Tk.6704.0 and the output-input ratio was 4.5

Forest and agri-cultivation are mixed up. The physical configuration of the North Mymensingh belt of sal forest is slightly different. They are situated on irregular masses of broken heights with a maximum of around 500ft. from mean sea level.

The soils in the sal forest area are mostly terrace red and brown soils having moderate nutrient status. The upper part is generally clay loam and the lower part silty clay or clay.

In the part of the study area, especially in the forest area of Bhaluka, Muktagacha, Fulbaria, Sribardi, Nalitabari, Jhinaigati, Bakshigonj, Haluaghat, Dhubaura, Durgaupur, Kalmakanda Thanas have unique feature of land occupation. In the first three thanas and also in the Jamalpur sadar Thana, forest areas are under tremendous pressure of encroachment. Most of the encroachers are migratory in nature, industrialists and have been initiated by its illegal tenancy right since the regime of Zaminder.

By the State Acquisition and Tenancy Act, 1950, the forest have been classified as non- retain able properties and subsequently it was acquired by the government. But due to its accessible nature and excessive growth of population forests lose its vegetative cover and have converted it into arable lands.

Though the legal ownership still lies with the government, the traditional practice of forest management and plantation raising proved obsolete and unsuccessful with the change in Socioeconomic and political condition of the area.

Considering the Socioeconomic condition of the people adjoining the forest, Government has decided to rehabilitate these inland sal forest by participatory forestry, and thus benefit sharing approach (with beneficiary group) of forest management was evolved. From this realization participatory forestry programmes like Community Forestry Project (CFP), and Thana Afforestation and Nursrsy Development Project (TANDP) were initiated and the benefit sharing mechanism at 50/50 was agreed upon.

## Technical and Economic Performance

Participant grows agricultural, root and fruit crops in the alley space. Initially alley found to be quite spacious and least shading. But the agricultural productivity went down after 3rd/4th growing season.

**Paddy Yield -** A case study was carried out in 1994 by Bhuiyan in Dinajpur forest Division. The trend of yield of paddy was assessed in 4 plantations covering an area of 36.03 ha over the period of 7 years. In each case, alley width was 10m and associated tree species were Eucalyptus, Acacia auriculiformis and Dalbergia sissoo.

**Table - 4. Trend of Paddy Reduction in Dinajpur Forest Division (Agroforestry Plot)**

| Year of Plantation | Area (ha.) | Trend of crop yeild reduction (in kg/ha/yr.) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th |
| 1985 | 6.07 | 2316 | 2084 | 1853 | 1039 | 740 | 714 | 390 |
| 1986 | 10.12 | 1673 | 1282 | 478 | 125 | — | — | — |
| 1987 | 10.12 | 1400 | 1301 | 1126 | 603 | — | — | — |

As shows in the table -4, paddy yield shows gradual reduction in successive years; in some case farmer have abandoned paddy cultivation due to poor yield after 4th year.

**Pineapple** - Another survey was conducted in 1996 in the plantation of 1991 of Sagardhighi in Tangail Forest Division (adjacent to the study area) where every family allotted 0.40 to 0.60 ha of land. Agricultural crops like paddy, sesame, turmeric, ginger, jute and pineapple were cultivated in the alley space. During the survey 43 participants were taken as sample, out of that 15 families cultivated pineapple from 2nd year of cultivation. Income generated from pineapple is summarized in Table - 5

### Table – 5. Income from pineapple cultivation (in tk/ha./year).

| Year-1 | | Year-2 | | Year-3 | | Year-4 | | Year-5 | | Year-6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Input | Output | Income | Output | Input | Output | Input | Output | Input | Output | Input | Output |
| 11168 | — | 2460 | — | 2780 | 11862 | 3715 | 30784 | 3676 | 24500 | 2700 | 16867 |

Income from pineapple was promising. Despite having income in 1st and 2nd year, but in 3rd, 4th,5th and 6th year increase of income was about 426%, 828%, 666% and 624% respectively, over the value inputs.

**Ginger -** Similar survey was conducted for quantifying performance of ginger cultivation. In total 12 participating families' income were evaluated.

### Table – 6. Income from ginger cultivation (Tk/ha/yr.)

| Year-1 | | Year-2 | | Year-3 | | Year-4 | | Year-5 | |
|---|---|---|---|---|---|---|---|---|---|
| Input | Output | Input | Output | Input | Output | Input | Output | Input | Output |
| — | — | 27000 | 105000 | 25500 | 80000 | 22076 | 66500 | 23600 | 62500 |
| | | | 388% | | 313% | | 301% | | 264% |

Participants cultivated ginger in an average on 0.15 ha. Income from ginger was very attractive and farmers earn lucrative amount of money from the practice, which was as high as TK.105000/ha/year (as shown in the table-6). The income increase was 316% in an average (Rahman, 1997).

## Performance of Trees Crops:

As stated by Bhuyian in 1994, plantation raised in 1985 and which was felled in 1993.

### Table-7: Wood production in agroforestry farm in Dinajpur (8-years rotation).

| Area in ha | Species | Agriforestry Model | Timber(cum) | Fuelwood(cum) |
|---|---|---|---|---|
| 6.05 | Eucalyptus and A auriculiformis | Alley cropping with 2rows of trees. | 187.33 | 267.70 |

As shown in the above table, a total production was 455.03cum from 6.05 ha plot in 8 years, which is about 9 cum/ha/year in agroforestry scale (25% area under tree crops). So the productivity was quite promising .

**Economic performance:** - At the final harvest average sale values of wood was TK 285,430, similarly agricultural crops total value out turn TK 136,412.

### Table: 8. Value out turn from Agriculture and wood source (in Tk)

| Value of Agri-crops (Tk.) | plantation (crops) | Sale value of wood . |
|---|---|---|
| 13641.2 | 31500 | 28543 |

As shown in the table 8, every family earns an average of Tk. 28543 (50% of the sale proceeds) and TK 3400.0 from wood sale value and agricultural crops respectively.

In come from agri-crops is quite low but this can be minimized through cultivating pineapple and ginger as shade crops (table-5-and 6)

**Farmers performance and profitability**:- Final harvest of trees in 1993 and subsequent distribution of share among the farmers has earned confidence in about the agroforestry production system.

A landless family received Tk. 28543 in cash, practically without any investment. Having joined in the programme they are now owners of 1.21 ha of land, which is capable of producing family's yearly subsistence.

# CHAPTER – 3

## 3. DESCRIPTION OF THE STUDY AREA: -

**3.1. Location:** The study area Mymensingh Forest Division comprises with five new districts namely Mymensingh, Jamalpur, Kishoregonj, Netrokona and Sherpur lies between $20^0$-30 and $25^0$-30 north latitudes and $89^0 45'$ and $91^0\ 10'$ east longitudes. The Division is bounded on the north by Garo hills of India on the east by Sylhet districts, south by Dhaka and Tangail districts and on the west Tangail, Bogra and Rangpur districts. The study area has an area of 13,298-sq. km., which constitutes 9.21% of the total area of the country.

**Table – 9: Population of Mymensingh Forest Division.**

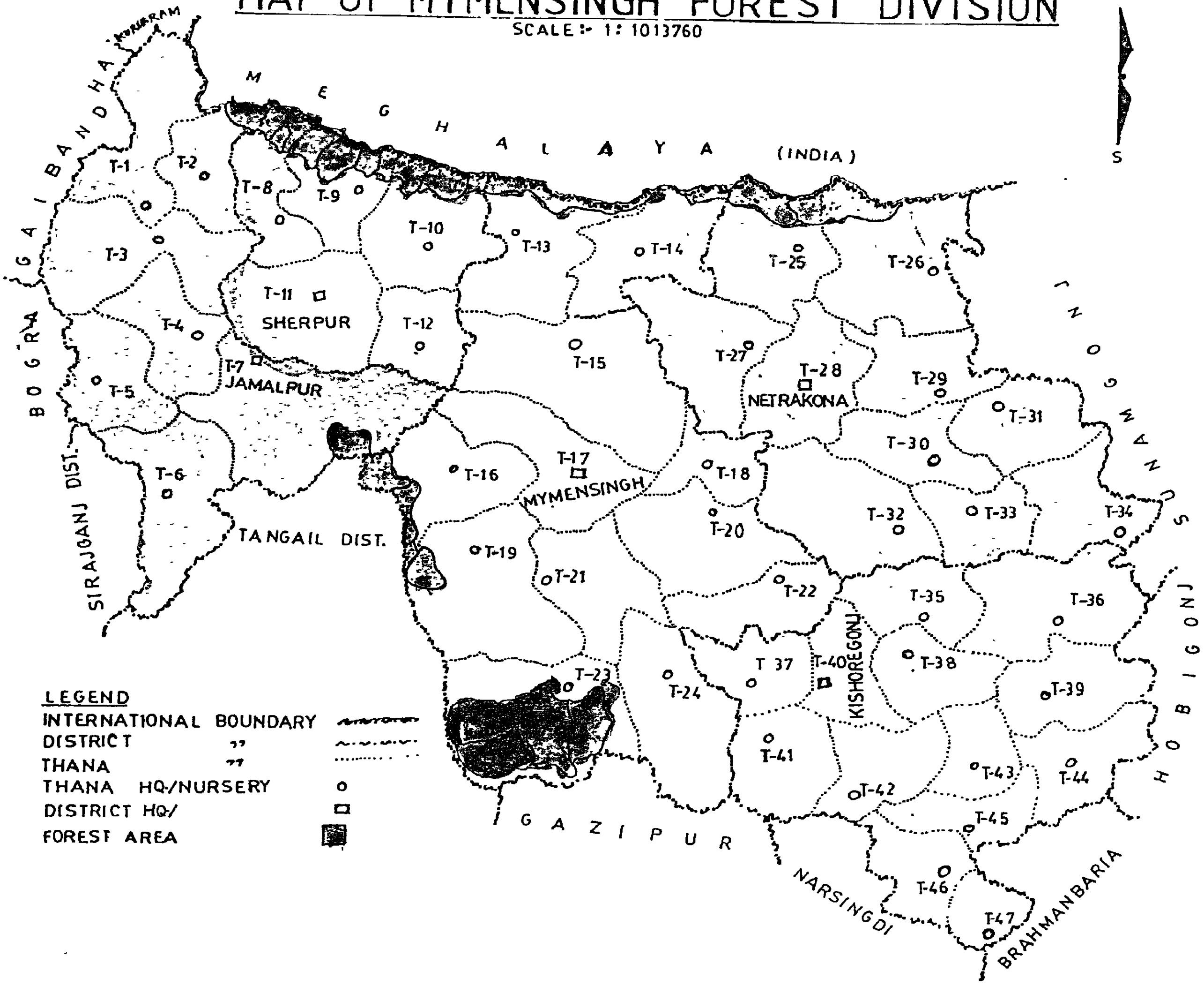
| District or Zilla | Area (km) | No. of Thana | No. of Rural Mouzas | House holders | Population |
|---|---|---|---|---|---|
| 1. Mymensingh | 4363 | 12 | 1984 | 7,80,000 | 30.72.440 |
| 2. Jamalpur | 2032 | 7 | 727 | 3.79.545 | 19.42.000 |
| 3. Netrokona | 2810 | 10 | 1014 | 3,34.202 | 17,90.785 |
| 4.Kishoregonj | 2689 | 13 | 1711 | 4.30.000 | 24.77.792 |
| 5. Sherpur | 1364 | 5 | 662 | 2.24.186 | 12.09.388 |

**3.2. Climate:** There are three distinct seasons each approximately four months long; a cool and dry winter (Nov to Feb), a hot dry season (March, April, May, some time June and a pronounced monsoon rainy season begins from May or June depending on the change of wind direction and ends in September.

The Monsoon rain begins in May/June and continues until September or October. The monsoon period is characterised by heavy rainfall, high relative humidity and sometimes prolonged rain showers for several days. Rainfall is considerably higher in the north and northeastern part of the division. The annual rainfall at Mymensingh station during the year 1995 was 3215 mm. The cool winter season sometimes experiences light rainfall. The study area is not usually experienced with frost.

# MAP OF MYMENSINGH FOREST DIVISION

SCALE :- 1: 1013760



| CODE | NAME |
|---|---|
| T-1 | DEANGANJ |
| T-2 | BOKSIGANJ |
| T-3 | ISLAMPUR |
| T-4 | MALANDAH |
| T-5 | MATHERGANJ |
| T-6 | SORISABARI |
| T-7 | JAMALPUR SADAR |
| T-8 | SREEBORDI |
| T-9 | JHINAIGATI |
| T-10 | NALITABARI |
| T-11 | SHERPUR SADAR |
| T-12 | NOKLA |
| T-13 | HALUAGHAT |
| T-14 | DHOBAURA |
| T-15 | FULPUR |
| T-16 | MUKTAGACHA |
| T-17 | MYMENSINGH SADAR |
| T-18 | GOWRIPUR |
| T-19 | FULBARIA |
| T-20 | ISWARGANJ |
| T-21 | TRISAL |
| T-22 | NANDIL |
| T-23 | BHALUKA |
| T-24 | GAFURGOAN |
| T-25 | DURGAPUR |
| T-26 | KALMAKANDA |
| T-27 | PURBADHALA |
| T-28 | NETRAKONA SADAR |
| T-29 | BARHATTA |
| T-30 | ATPARA |
| T-31 | MOHANGANJ |
| T-32 | KENDUA |
| T-33 | MADAN |
| T-34 | KHALIAJURI |
| T-35 | TARAIL |
| T-36 | ITNA |
| T-37 | HOSHENPUR |
| T-38 | KARIMGANJ |
| T-39 | MITAMAIN |
| T-40 | KISHOREGANJ SADAR |
| T-41 | PAKUNDIA |
| T-42 | KATHIADI |
| T-43 | NIKLI |
| T-44 | ASTAGRAM |
| T-45 | BAJITPUR |
| T-46 | KULIARCHAR |
| T-47 | BHAIRAB |

The average maximum temperature at Mymensingh station varies from 33.8$^0$c to 37$^0$c and the minimum 8.5$^0$ to17.3$^0$c.

3.3. **Land and soil :** The area of Mymensingh Forest Division occupies mainly high and medium high land. High and medium high land constitute more than 60% of the total area. These high and medium high lands are almost plain in nature. Few areas are hilly in the districts of Jamalpur, Sherpur and Netrokona. Besides, there are some low lands (locally known as haor) in the study area which constitutes almost two third of the total area of Kishoregonj and Netrokona districts. Most of the haor lands remain submerged during the monsoon seasons.

**Bramer (FAO, 1988) has define the physiographic units within the division:**

- Madhupur Tract-Brahmaputra flood plain.
- Meghna Estuarine flood plain, southern part of the forest is found in the Madhupur tract.

**The following general soil types Occur in the mentioned physiographic units:**

- Madhupur Tracts-Deep Red Brown Terrace soils,
- Brahmaputra- Non calcareous Grey flood plain soils
- Flood plain soils (Non saline)
- Meghna Estuarine- Non calcareous Grey flood plain soils.
- Flood plain-calcareous alluvium (non-saline).

The common properties of the main soils are described below: -

**Deep Red-Brown Terrace soils, covering mainly the part of Madhupur.**

Well drained to moderately well drained, red to yellow brown soils with a overlying of strongly red mottled pervious clay substratum. The soil is strongly or very strongly acid in nature.

**Noncalcareous Grey Floodplain soils, which is nonsaline.**

Seasonally flooded soils: Topsoil generally slightly to very strongly acid (when not submerged), lower layers are generally slightly acid to moderately alkaline.

**Calcareous Dark, Grey Floodplain soils.**

Seasonally Flooded soils: - Many basin soils have a neutral to acid topsoil and a neutral dark Grey gleyans or pressure faces; subsoil over a calcareous substratum at 40-60 cm

**Non calcareous Dark Grey Flood plain soils: -**

Seasonally Flooded soils: not calcareous with in 125 cm from surface topsoil generally, slightly to strongly acid (when not submerged), lower layers generally are slightly acid to moderately alkaline,

## A. Socio-economic profile of Mymensingh Forest Division: -

| Attributes | Present Situation |
|---|---|
| **Economic** | |
| Average firm size | 0.29 ha |
| Percent of household with live stock | 37.2% |
| Main income source of household | Farming(42.60% of the household) |
| Average annual per house hold income (Tk.) | |
| Both Sex | 8220/- |
| Male | 10,760/- |
| Female | 5280/- |
| Average annual Expenditure | 8800/ |
| **Demographic** | |
| Household(total) | 2151933 Nos. |
| % Land less | 58.14%. |
| % Land owned | 41.86% |
| Average household size | 5.30 Ac. |
| % Population below poverty level | 63.80% |
| Female headed household | 2.05% |
| Main energy Source for | |
| Cooking | Fuel wood/Agriculture residues, Leaves, twigs etc. |
| Lighting | Kerosene |

### 3.4. Land uses in Mymensingh Forest Division.

**Forest use:** The Study area falls within the zone of tropical moist deciduous forest. Champion et al (1956) described the remnant forest as moist sal forest. The forest has been subjected to extreme pressure from the growing population and is now restricted to fragment blocks, heavily cut over, regrowing by coppice. The dominant species is Sal (Shorea robusta) normally associated with other species such as Koroi: Albizia procera, Terminalia belerica, chalta: Dillenia pentagyna with Malsa velutina and Cassia fistula on the fringes of the woodland.

The extent of legal forest resources within the study area is summarized in the table below:

**Table: 10. Area Statement of Mymensingh Forest Division (ha).**

| District | Reserved Forest | Protected Forest | Acquired Forest | Total Area |
|---|---|---|---|---|
| **Mymensingh** | 3,383.32 | 638.62 | 11,646.58 | 15,668.52 |
| **Jamalpur** | — | — | 4,196.11 | 4,196.11 |
| **Sherpur** | — | — | 7,882.06 | 7,882.06 |
| **Netrokona** | — | — | 734.74 | 734.74 |
| **Kishoregonj** | — | — | — | — |
| **Total** | 3,383.32 | 638.62 | 24,463.49 | 28,485.42 |

It can be seen that the forest is concentrate mostly to Sherpur and Mymensingh District.

Under some development projects wood lot and Agroforestry plantations were established with the active participation of the local people on benefit sharing basis. Acacia auriculiformis and Eucalyptus camaldulensis are the major species planted in the wood lot and Agroforestry plantations with some other species as Terminalia arjuna and Gmelina arborea. The total planted area under wood lot and Agroforestry practices in the degraded Sal forest area is shown in the following table.

**Table .11. Wood lot and Agroforestry plantation in ha. (1988 to 1997).**

| Type of Plantation | District | | | | | | No of participants | |
|---|---|---|---|---|---|---|---|---|
| | Mymensingh | Netrokona | Sherpur | Jamalpur | Kishoregonj | Total | Man | Woman |
| Agroforestry | 1799.44 | — | — | — | — | 1799.44 | 1404 | 122 |
| Wood lot | 1410.85 | 600.25 | 3376.74 | 729.5 | — | 6117.34 | 5407 | 143 |
| Total | 3210.29 | 600.25 | 3376.74 | 729.5 | — | 7916.78 | 6811 | 265 |

Fig. 5. Agroforestry Plot at Rasulpur range under Mymensigh forests Division.

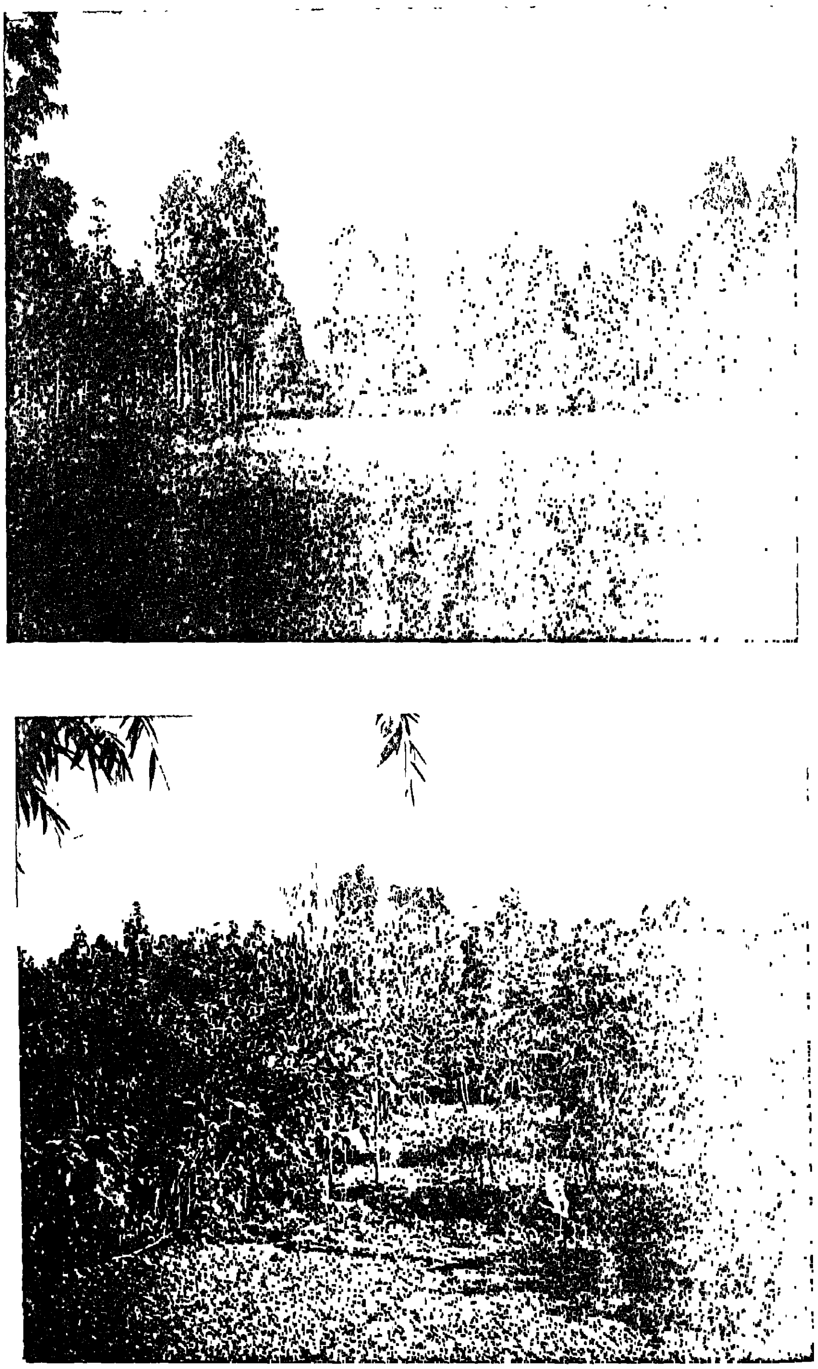


Fig 5. Agroforestry in Rasulpur Range (Study Area)

Fg. 5. Agroforestry in Study Area

Agroforestry in Study Area

Fig. 5. Agroforestry in Study Area

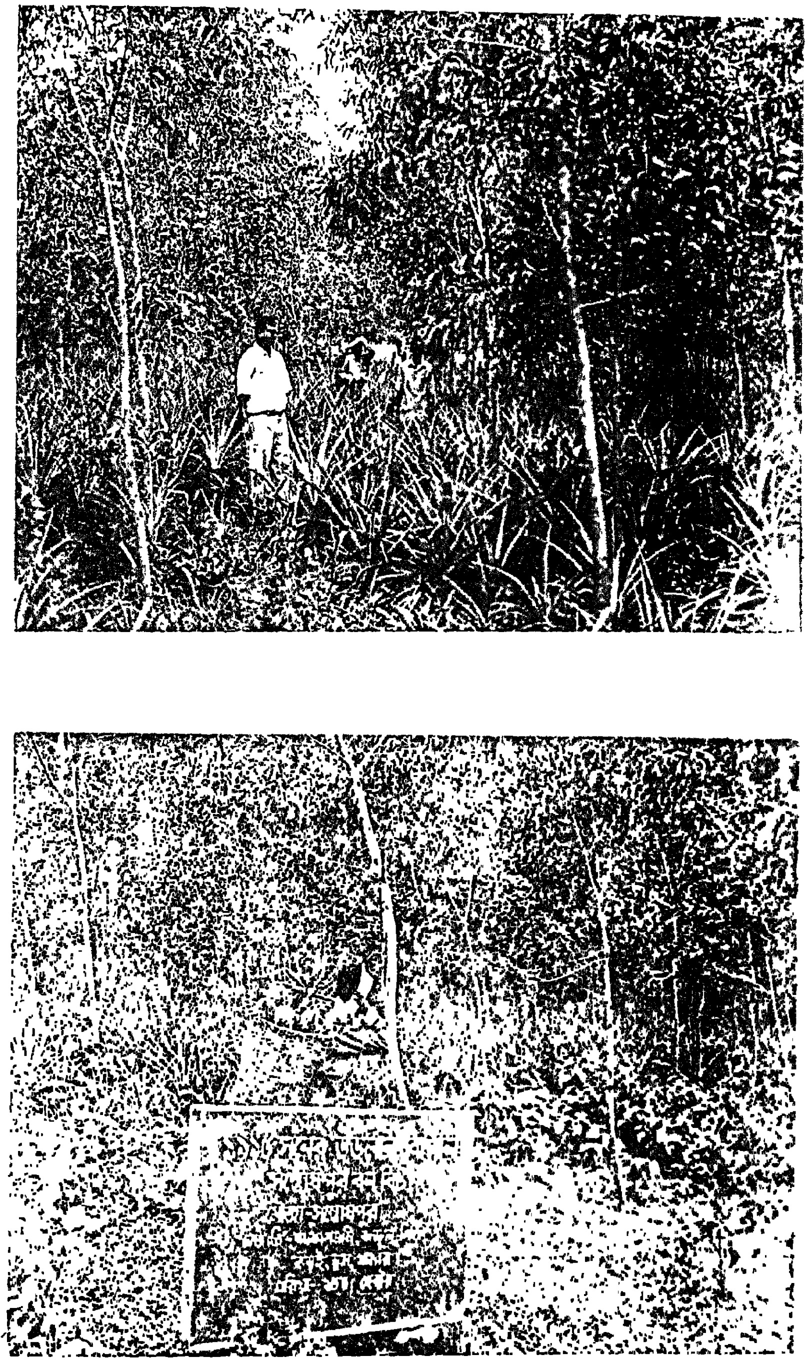


Fig .6. Woodlot Plantation in Rasulpur Range

Fig.6. Wood lot plantation at Rasulpur Range under Mymensingh forests Division.

In addition to Wood lot and Agroforestry plantations some Bamboo, Cane & Murta plantations were also raised under development scheme which are shown is the table were;

**Table: 12. Bamboo, Cane & Murta plantation in ha. (1991- to 1997).**

| District | Bamboo Plantation | Cane Plantation | Murta Plantation | Total |
|---|---|---|---|---|
| Mymensingh | 30.36 | 34.01 | — | 64.37 |
| Jamalpur | 26.32 | — | — | 26.32 |
| Sherpur | 26.32 | — | 4.05 | 30.37 |
| Netrokona | 8.10 | — | — | 8.10 |
| Kishoregonj | — | — | — | — |
| Total | 91.1 | 34.01 | 4.05 | 129.16 |

In Mymensingh forest Division, Strip plantation and Plantation in the premises of different Institution have been established during the period 1988 -1997 under some development projects which are show in table -13.

**Table: 13. Strip & Institution plantation during the year 1988-1997.**

| Plantation Established during 1988-1997 | | | | | | |
|---|---|---|---|---|---|---|
| District | Strip plantation (km) | | | | | Institution Planting (No) |
| | Roads & High way | Rail way | Embankment | Feeder Road | Total | |
| Mymensingh | 112 | 45 | — | 373 | 530 | 241364 |
| Sherpur | 52 | | 10 | 67 | 129 | 78320 |
| Jamalpur | 19 | 36 | 15 | 51 | 121 | 96270 |
| Netrokona | 88 | 49 | 6 | 187 | 330 | 120360 |
| Kishoregonj | 81 | 13 | — | 179 | 273 | 138620 |
| Total | 352 | 143 | 31 | 857 | | 676934 |

Fig.7. Strip plantation at Mymensingh district and Mymensingh forest Division.

Fig 8. Homestead is Agroforestry in study area.

Fig 9. A typical homestead in Woodlot plantation.

Fig 10. Pineapples (Output from Agroforestry plot) carried by the participants, taken into the market.

Fig 11. Village market, near Agroforestry plot, where the participants sale their products (Pineapple, Jack fruits)

Fig.12. Institution plantation in Mymensingh under forestry development program

Most homesteads in the study area are dominated by some trees such as Mangifera indica, Artocarpus heterophyllus, Syzgium spp, Cocos nucifera, Samanea saman, Albizzia spp., Lagerstroemia spp., Zizyphus jujuba, Areca catechu, Azadirachta indica, Amoora rohituka etc.

The main species of wet land in the haor is Hizol: Barringtonia accutangulata.

**Agricultural Use:** Cultivated Chala upland soils grow poor crops of early Aus rice. Mustard, beans and legumes. The lower flat baid land is used for T Aman rice in the heighst parts and for Aus followed by T.Aman on the wetter sites. A winter HYV bore or wheat is followed in the rainy season with irrigation by T-Aman. Field crops suitable for the study area are identified as in the appendix A- 1

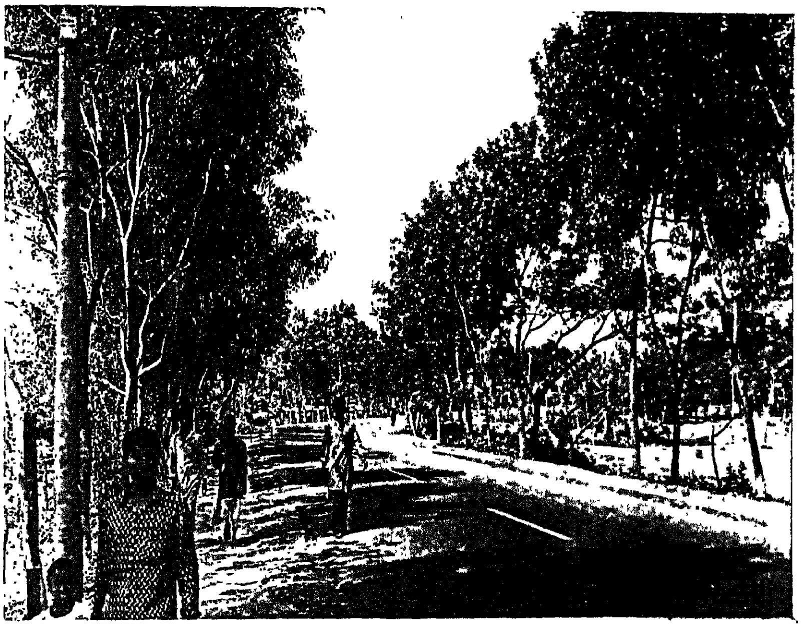


Fig. 7. Strip plantation in Study Area

Fig. 8. Homestead in Agroforestry plot

Fig. 9. A typical Homestead in Woodlot plantation

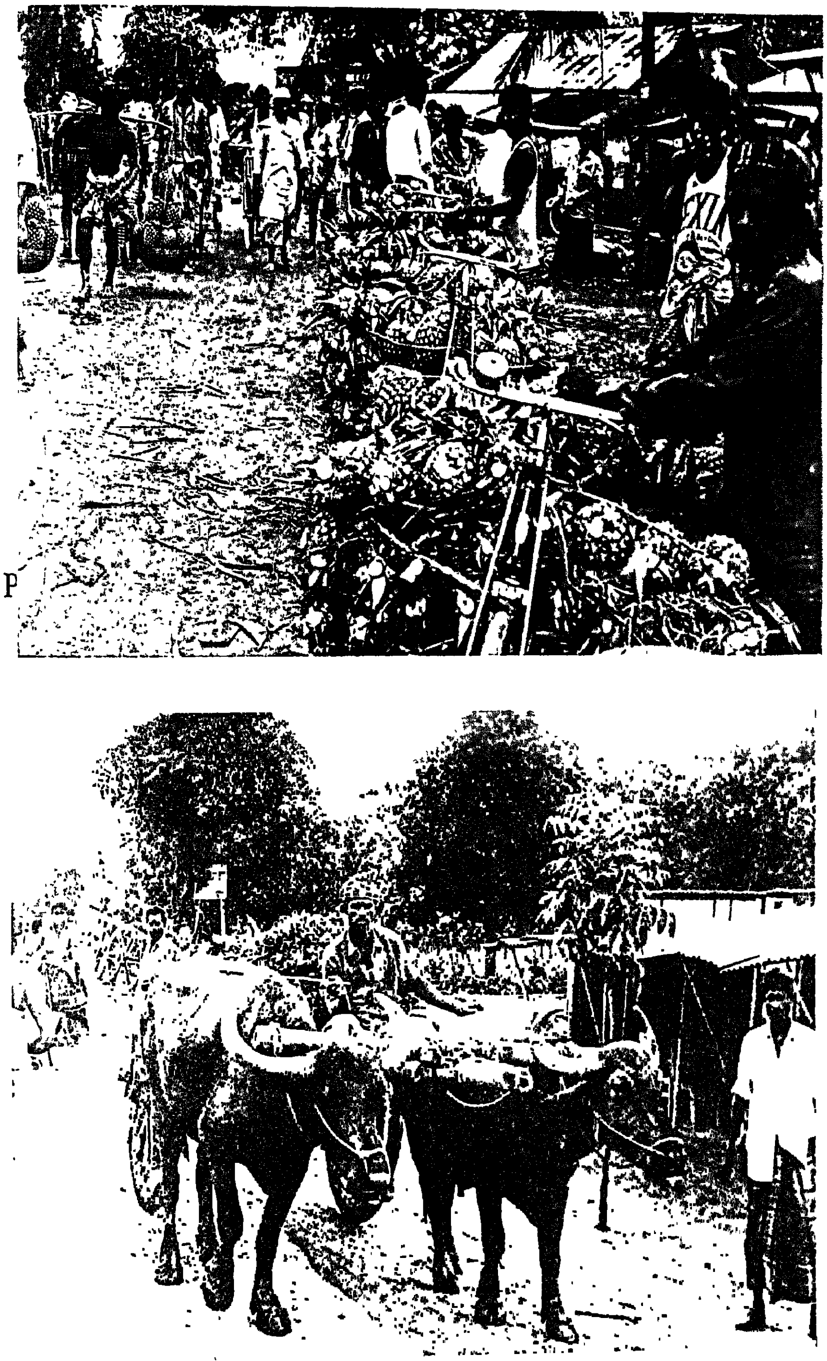


Fig.10. Pine-apples transportation in study Area

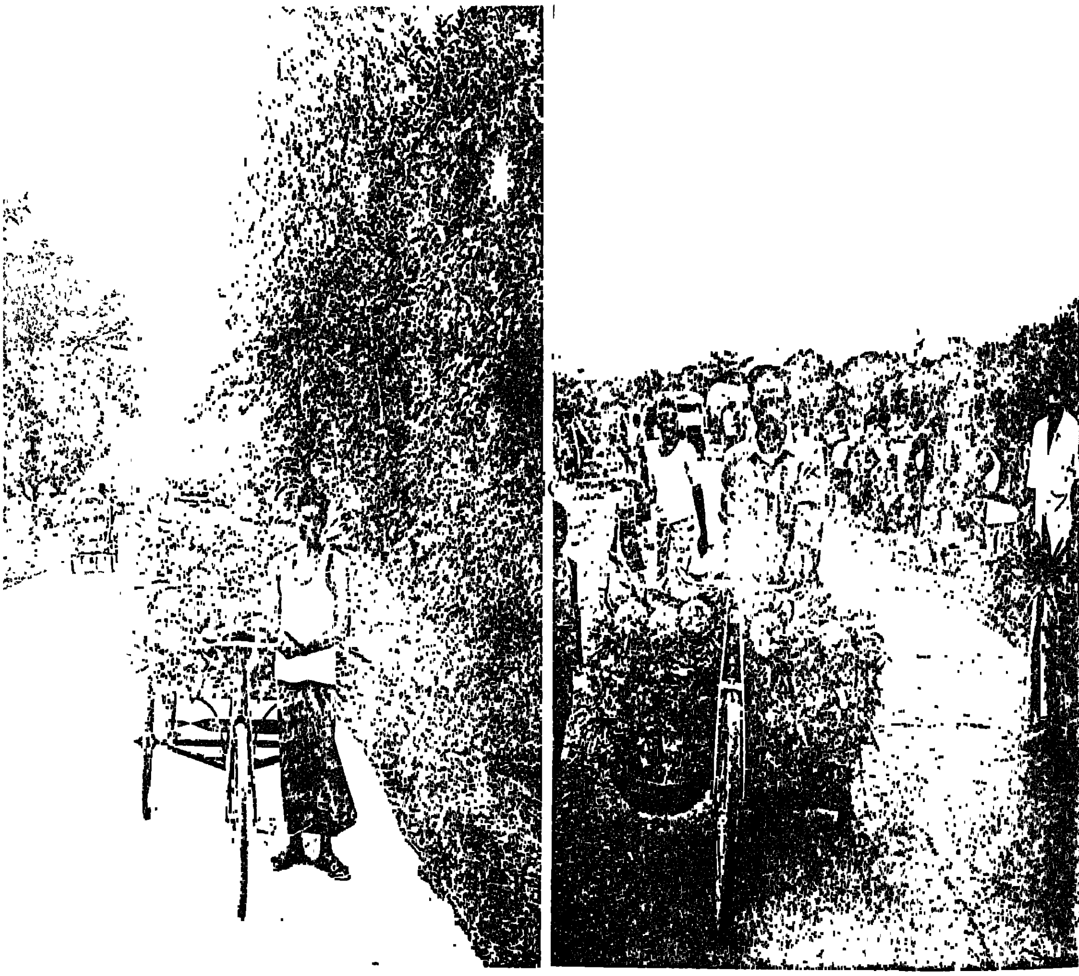


Fig. 10. Pine-apple transportation in Study Area

Pineapples marketing (Agroforestry Products) in Study Area

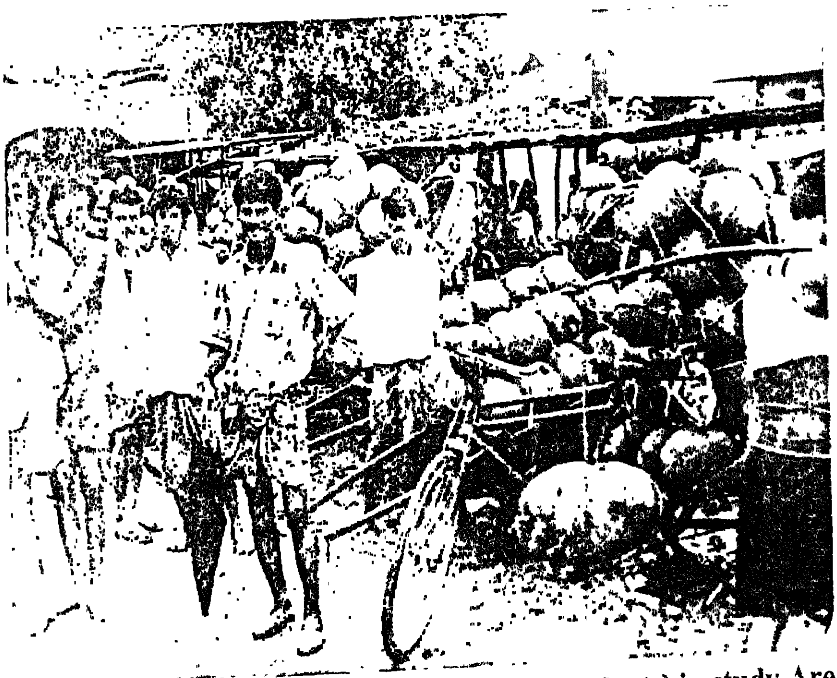


Fig .11. Jackfruits marketing (Agroforestry Products) in study Area

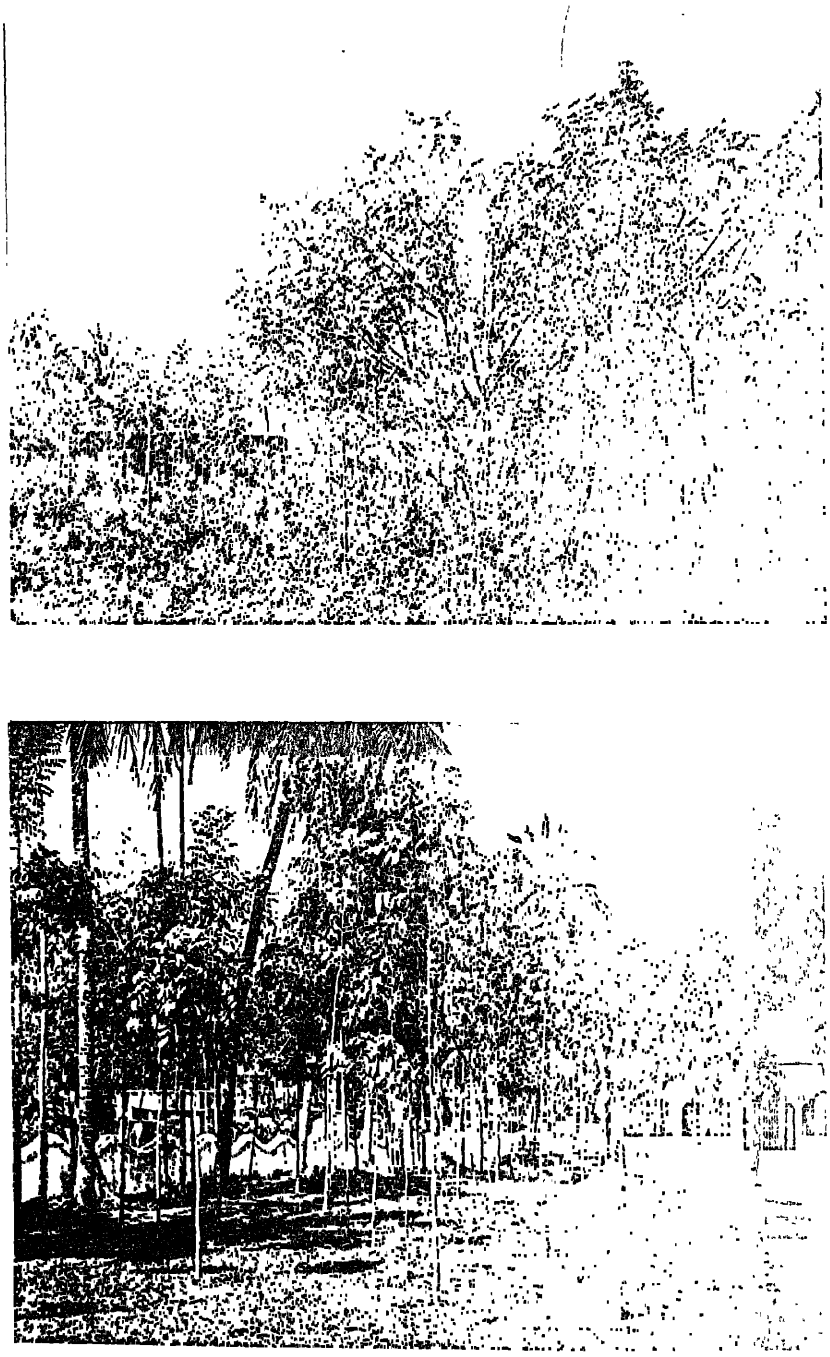


Fig. 12. Institution Plantation in Mymensingh

# CHAPTER-4

## 4. STUDY OBJECTIVES

The study objectives of the project are:

1. To identify sustainable land use practice in forestry sector.
2. To recover encroached Govt. forest lands and put under afforestation & cultivation.
3. Soil conservation, watershed management, biodiversity and ecological balance of the study area.
4. Income generation activities in the study area.
5. Poverty alleviation.
6. To prevent environmental degradation in the study area.

# CHAPTER-5

## 5. METHODOLOGY:

### 5.1. Methods of data collection:

The data collections are based on the nature of data needed to meet the study objectives. Both primary and secondary data are collected. Data collection methods used are as follows: a) Preparation of an inventory of relevant document & reports.

b) Review and consultation of necessary reports & documents.

c) Field interview with pre-set questionnaire.

### 5.2 Study Areas and Sample Interviews

47 Thanas and 5 Ranges within the 5 civil districts of Mymenshing Forest Division were the study areas of the Survey. The name of Thanas and ranges within the 5 districts are mentioned in Appendix -2. Random sampling procedure was followed during data collection from each and every Thana and Range. A total of 1400 persons were interviewed of which 940 from 47 Thanas and 460 from 5 Ranges. District and Ranges wise lists of interviewed persons are shown in Appendix 3(A) and 3(B), Four categories of people namely farmers, businessmen, daily labor and service holder were interviewed taking 5 parsons from each category in each Thana and Range. Out of total interviewed persons 500 from five districts (100 from each district) and 400 from five ranges (80 from each range) were selected on lottery basis for compilation and analysis of data. In the selection process of data compilation each and every Thana, Range as well as profession was covered.

During the survey, sub professionals were collected data. 70 interviewers, all of them having University degrees. Before sending the interviewers for surveying in the field they were given two day orientation course on the scope and importance of the study, interview techniques, study methodologies, accuracy of data to be collected etc. There was provision of supervision and monitoring during the period of data collection. Five Professionals having professional forestry degrees have checking, entry, compilation the data and analyzed the data.

Questionnaire used in data collection shown in Appendix-4.

## 5.3 Study Findings:

### 5.3.1. Environmental & Tree Issue:

Table 14: Shows that 81% of the interviewed persons were aware about environment and about the benefit of trees in case of the districts, where as in case of ranges 71% of the persons were known about the environment and 81% about the benefit of tree.

**Table 14: Persons aware about Environment and Benefits of trees (%).**

| Studied Area | Interviewed persons aware about environment | | Interviewed persons know about the benefit of a tree | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| **District** | 81 | 19 | 81 | 19 |
| **Range** | 77 | 23 | 81 | 19 |

### 5.3.2. Beneficiary of Forest Department:

It is shown in the table that only 26% of the interviewed persons were the member of the beneficiary groups of Forest Department in case of the districts and 46%, in case of the ranges.

**Table 15: Beneficiary of Forest Department (%)**

| Studied Area | Beneficiary of FD | | Willing to be a Beneficiary of FD | |
|---|---|---|---|---|
| | Yes | No | Yes | No |
| District | 26 | 74 | 94 | 6 |
| Range | 46 | 54 | 77 | 23 |

### 5.3.3. Home stead Areas:

In the districts 68.8% people have their homestead area of less than 0.25 acre and 31.2% people have more than 0.25 acre of home-stead area in the table-16. Where as in case of Ranges 58% of the interviewed persons have less than 0.25 acre and 42% persons have more than 0.25 acre of homestead land.

**Table 16: District and Range wise status of homestead area.**

| Study area | Persons having home stead area | |
|---|---|---|
| Districts | <0.25 acre =68.8% | >0.25 acre =31.2% |
| Ranges | <0.25 acre =58% | >0.25 acre=42% |

### 5.3.4. Land Ownership:

Table-17, shows in districts out of the total interviewed persons 40.4% possess less than 0.5 acre of land, 26% people belong to 0.5 to 3.0 acre, while 33.6% people have more than 3.0 acre of land. But in case of ranges it is shown that 39% people possess less than 0.5 acre, 27.6% belong to 0.5 to 3.0 acre and 33.4% people have more than 3.0 acre of land.

**Table 17: District and Range wise status of land ownership**

| Study area | Land ownership (%) | | |
|---|---|---|---|
| | <0.5 acre | 0.5-3.0 acre | >3.0 acre |
| Districts | 40.4 | 26.0 | 33.6 |
| Ranges | 39.0 | 27.6 | 33.4 |

### 5.3.5. Income position:

Table 18. Expresses that of the interviewed persons in district 82% people earns

up to 5000.00 (five thousand) taka per month where as 18% people have their earning more than 5000.00 (five thousand) taka per month. In case of ranges, 91.2% people earns upto 5000.00 (five thousand) taka per month, and 8.8% people earns more than 5000.00 (Five thousand) taka per month.

**Table 18: Income position of the interviewed persons.**

| Study area | percentage of persons having monthly income | |
|---|---|---|
| | <Tk. 5000.00 | > Tk. 5000.00 |
| District | 82 | 18 |
| Range | 91.2 | 8.8 |

It is worth mentioning that 94% of the interviewed person of the districts and 77% of that of the ranges shown their interests to be a member of the beneficiary group of forest department (Table-15).

### 5.3.6. Interests in land use practices Agroforestry, Woodlot.

Table 19: indicates that in district 75% persons shows their interest in agroforestry practices, where as it is 70% in case of ranges. But in the wood lot practices, only 37% and 40% shows their interest in case of districts and ranges respectively.

**Table - 19: Persons interested in Agroforestry and wood lot (%).**

| Studied Area | Interested in | | | |
|---|---|---|---|---|
| | Agroforestry | | Wood lot | |
| | Yes | No | Yes | No |
| District | 75 | 25 | 37 | 63 |
| Range | 70 | 30 | 40 | 60 |

# CHAPTER-6

## 6. DISCUSSION AND RECOMMENDATION

Due to the deteriorating condition of the forest cover and increasing demand of forest products drew the attention of Government. Traditional practices of forest management have failed to conserve and extend the forest resources due to gradual changes of socio-economic condition and non-cooperation of the local people.

The changes of the socio-economic condition, the people oriented participatory forestry should be introduced. Experience grained from Betagi-Pomora community forestry project and alley cropping agroforestry model of Dinajpur may be incorporated in the next forestry practices.

The extent of forest and marginal land with potentials for agroforestry development is about 1.51 million ha (Bhuiyan, 1993).

Homestead Agroforestry, Cropland Agroforestry, Agroforestry for the rehabilitation of degraded sal forest, and Roadside Agroforestry may be developed in the study area.

### 6.1. Homestead Agroforestry

The homestead agroforestry, traditionally are the most successful, production and acceptable form of Agroforestry here. Multipurpose trees, fruit trees shrubs and the villagers in the homesteads generally grow vegetables. Homesteads are the source of food, fruit and fuel and fodder, timber and cash income in emergency. Homestead forests account about 11% of the forestland and fulfil 86% of the total consumption of the country.

**Recommendation:**

i. Qualitative improvement by planting improved variety of fruit and tree species in association vegetables, spices etc.

ii. Selective thinning may be introduced to provide space, light and food for the desired plants.

## 6.2. Cropland Agroforestry:-

Cropland Agroforesty is getting attention of the farmers as well as extension workers. Diversification of products and higher productivity is ensured in spite of shading effect and reduction in crop production.

**Recommendation: -**

i. Wider spaced planting should be employed to minimize crop losses.
ii. Deep rooted, narrow crowned tree species to be selected.
iii. Management practices like pruning, lopping, pollarding may be adopted.

## 6.3 Agroforestry for the Rehabilitation of the Degraded Sal Forests:

In degraded sal forests, Agroforestry practice was found technically sound. economically viable and socially acceptable. People's participation on benefit sharing basis was ensured. Handsome amount of degraded and encroached sal forestland could be brought under tree cover through Agroforestry approach.

**Recommendation: -**

i. Provision of widening of alley.
ii. Introduction of thinning practice.
iii. Prefers shade-loving Agri-crops like ginger, pineapple, banana, and turmeric for planting in the alley space.

## 6.4. Roadside Agroforestry.

Concept of planned Roadside forestry is not new in Bangladesh. But considerable amount of space for production of agri-crop is also seen along the roadside. Agroforestry practice along the roadside seems to be new. It offer an ample opportunity for raising seasonal crops like beans, pulses, pigeon pea, Black gram, cow peas etc. along with fruit and tree species.

### Recommendation: -

i. Non-palatable light crowned multipurpose tree species (6' and above height) to be selected for planting.

ii. Involvement of local people (specially the owner and farmer of the adjacent Agri- land) as a participant on benefit-sharing basis.

iii. Provision of paid watcher for maintenance of the plantation (3yrs.).

iv. Agreement regarding land use and land tenure should be done in due time.

v. Proper coordination among the land owning agency, Forest Department, Union council & beneficiary group, NGO's should be ensured.

# CHAPTER-7

## 7. Conclusion:

Agroforestry systems practiced in the Dinajpur, Betagi Pomora area, have proven to a sustainable production system. It ensures diversified products and year round yield From the data it was observed that, farmer can satisfy their day to day need and can improve their quality of life, their post settlement income has increased (Tab-1); Agroforestry crops account about 74% of their income (table - 2)

Social Acceptance of the agroforestry system was observed. It's attractive as once destitute landless encroachers become custodians of 1.21 ha of productive land, poor people organized to a dynamic group, farmers have earned confidence over the system and accepted the concept.

Due to the adoption of agroforestry system by the participants benefit-sharing basis in the degraded/ encroached forest has land area the demanded/ degraded hand has transformed into a productive farm. The vegetative cover has increased and the system maintains the biological and ecological diversity.

From the survey it found that more than 80% of the interviewed person have shown interest in agroforestry and wanted to be a beneficiary of Forest Department.

So, form the above discussion the system is found to be economically, socially acceptable and ecologically suitable and sustainable.

To bring the homestead, cropland, degraded encroached sal forest of the study area under sustainable production system, Agroforestry in the form of Homestead Agroforestry, Cropland agroforestry, Roadside agroforestry and agroforestry in the sal forest should be adopted or practiced with the active involvement and participation of local people and organization.

# CHAPTER-8

## Appendix-I

## List of Field Crops Suitable for the Study Area

❑ **Cereals**

| English Name | Local Name | Scientific Name |
|---|---|---|
| 1. Broad Cast Aus | Aus | Oryza sative |
| 2. Maize | Bhutta | Zea mays |
| 3. Sorghum | Joar | Sorghum vulgare |
| 4. Wheat | Gam | Triticum aestivum |
| 5. Millet | Kaon | Setaria italica |

❑ **Vegetables**

| English Name | Local Name | Scientific Name |
|---|---|---|
| 1. Eggplant | Begun | Solanun melongena |
| 2. Tomato | Bilati Bagun | Lycopersicon esculentun |
| 3. Ladiesfinger | Dharas | Abelmoschus esculantus |

❑ **Pulses**

| English Name | Local Name | Scientific Name |
|---|---|---|
| 1. Pigeon Pea | Arhar | Cajanus cajan |
| 2. Blackgram | MashKalai | Phaseolus mungo |
| 3. Cow Pea | Barbati | Vigna sinensis |

❑ **Oil seeds**

| English Name | Local Name | Scientific Name |
|---|---|---|
| 1. Sesame | Jil | Sesamem indicum |
| 2. Mustard | Sharisha | Brassica juncea |
| 3 Soybean | Soybean | Glycine max |
| 4. Groundnut | China Badam | Arachis hypogaea |

☐ **Fruit crops**

| English Name | Local Name | Scientific Name |
|---|---|---|
| 1. Jack fruit | kathal | Artocarpus heterphyllus |
| 2. Mango | Am | Mangi-fera indica |
| 3. Pineapple | Anarash | Annas comosus |
| 4. Banana | Kala | Musa Sapieutum |
| 5. Shaddock | Jambura | Citrus grandis |
| 6. papaya | Papa | Carica papays |

☐ **Fodder Crops**

| English Name | Local Name | Scientific Name |
|---|---|---|
| 1. Blue Panic | | Panicum antidotala |
| 2. Napier | | |
| 3. Ipil-Ipil | Ipil Ipil | Leucaena leucocephala |
| 4. Dhaincha | Dhaincha | Sesbonia |
| 5. Cassava | Cassaba | |
| 6. Guinea | | |

☐ **Spices**

| English Name | Scientific Name |
|---|---|
| 1.Ginger | Zingiber officianale |
| 2.Turmerie | Curcuma domestica |
| 3.Chilli | Capsicam annum |

The lists of crops suggested above have both economic acceptability and also land suitability.

## Appendix -2 District wise Thanas and Ranges,

| Sl. No | District | Name of Thanas | No of Thanas | Name of Ranges | No of Ranges |
|---|---|---|---|---|---|
| 1. | Mymensingh | 1. Bhaluka 2. Dhobaura 3. Fulbaria<br>4. Gafargaon 5. Gouripur 6. Haluaghat<br>7. Iswergonj 8. Mymensingh Sadar<br>9. Muktagacha 10. Nandail 11. Fulpur<br>12. Trishal | 12 | 1. Rasulpur<br>2. Bhaluka | 2 |
| 2. | Jamalpur | 1. Jamalpur Sadar 2. Sarishabari<br>3. Melandaha 4. Islampur 5. Dewangonj<br>6. Madargonj 7. Boxigonj | 7 | | |
| 3. | Sherpur | 1. Sherpur sadar 2. Nakla 3. Zinaigati<br>4. Nalitabari 5. Sreebordi | 5 | 1. Rangtia<br>2. Balijuri | 2 |
| 4. | Netrokona | 1. Netrokona Sadar 2. Purbadala<br>3. Barhatta 4. Kendoa 5. Khaliajuri<br>6. Kalmakanda 7. Atpara 8. Madhon<br>9. Mohongonj 10. Durgapur | 10 | . Durgapur | 1 |
| 5. | Kishoregonj | 1. Kishoregonj Sadar 2. Hossainpur<br>3. Pakundia 4. Kotiadhi 5. Bajitpur<br>6. Kuliarchar 7. Bhairab 8. Austagram<br>9. Niklee 10. Mithamon 11. Itna<br>12. Tarail 13. Karimgonj | 13 | | |
| | Total | | 47 | | 5 |

## Appendix 3 (A) : District wise list of Interviewed persons.

| District | No of Thana | No of Professions | Persons Interviewed |
|---|---|---|---|
| Mymensingh | 12 | 4 | 12x4x5 = 240 |
| Netrokona | 10 | 4 | 10x4x5= 200 |
| Kishoregonj | 13 | 4 | 13x4x5 = 260 |
| Sherpur | 5 | 4 | 5x4x5= 100 |
| Jamalpur | 7 | 4 | 7x4x5= 140 |
| Total | 47 | | 940 |

## Appendix 3 (B) : Range wise list of Interviewed persons.

| Range | No of Beats | No of Professions | Persons Interviewed in each processions | Total Persons Interviewed |
|---|---|---|---|---|
| Balijuri | 4 | 4 | 5 | 80 |
| Rangtia | 6 | 4 | 5 | 120 |
| Bhaluka | 4 | 4 | 5 | 80 |
| Rasulpur | 4 | 4 | 5 | 80 |
| Durgapur | 5 | 4 | 5 | 100 |
| Total | 23 | | | 460 |

# Appendix - 4

## Questioner - I

**Information of Thana and Beat**

1. Name of the Thana/ Beat and area :
2. Population : Male: Female:
3. Number of Union & its Population : Male: Female:
4. No of Villages & its Population : Male: Female:
5. % of Education : Male: Female:
6. No of Landless :
7. No of Landlord :
8. No of Participants :
9. No of Tribal people :
10. No of Forest Villagers :
11. No of Large Industries : And its Labor force: Male: Female:
12. No of Small Industries :
13. No of People worked in the Industries:
14. No of Cottage Industries . :
15. Forest Plantation Raised :
    - a) Woodlot Plantation :
    - b) Agroforestry Plantation :
    - c) Strip Plantation :
    - d) Rail ways Plantation :
    - e) Embankment Plantation :
16. Other's if any :

## Questioner No - 2

**About Districts**

1. Area of the Districts & Population :
2. No of Thana & Population :
3. No of Union and Population :
4. No of Villages & Population :
5. Total Plantation : Male : Female :
6. % of Education : Male : Female :
7. No of Landless :
8. No of Landlord :
9. No of Large Industries :
10. No of People worked in the Industries:
    & their wages :
11. No of Small Industries :
12. No of Cottage Industries :
13. Other Information's (of any) :

## Questioner No – 3

**Socio-Economic Survey.**

1. Name of the persons :
2. Address :
    a) Fathers Name/ Husband's Name :
    b) Village & Post :
    c) police Station /Thana :
    d) District :
3. Profession :
4. No of Family Members : Son - Daughter -
5. Profession of the Children : No of person's go to School
6. Land area
    a) No of Crops in the land

b) Types of crops/ No of crops

c) Interested in Agroforestry

d) Interested in Woodlot Plantation

7. a) Areas in the House hold

b) No of Houses

c) No of Ponds : Whether there is any psciculture

d) No of Tree and Types of Sp. :

e) No of Cattle's :

f) No of Chickens/Ducks :

8. Are you participants of Forest Department :Strip / Woodlot / Agroforestry Plantation

9. a) Are you a Forest Encroacher :

b) How many area you have encroached (if)?

c) Type of crops Cultivated in the encroached land?

d) Why you have encroached the Govt. land?

e) Other than house what else you cultivate?

f) What is your monthly income?

g) Have you any house in any other place?

h) Whether you wanted to stay permanently?

i) Whether you wanted to raise plantation in that land?

j) Whether there is any fellow land? if so why not cultivated ?

k)If govt. take their land, then what they will do ?

l) Whether you wanted to be a participant of FD?

m) Are you be a group member of NGO?

If so than what facilities you are getting?

n) Do you know about usefulness of trees?

**Class of peoples to interviewed:**

1. Land lord
2. Agriculture
3. Businessmen
4. Service holder
5. Labor

# Chapter-9

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# Appendix-5

## (3) Organization working in Agroforesty Research, Development and Extension in Bangladesh-

### GOB organization

1. Bangladesh Forest Department (BFD)
2. Bangladesh Agricultural Research council (BARC)
3. Bangladesh Forest Research Institute (BFRI)
4. Bangladesh Agricultural Research council (BARI)
5. Bangladesh Livestock Research Institute (BLRI)
6. Institute of Forestry and Environmental Science , Chittagong University (IFESCU)
7. Bangladesh Agricultural University (BAU)

### Non. Government Organization

1. Bangladesh Rural Advancement Committee
2. Proshika
3. Care-International

### Donor Agencies

1. Swiss Development Corporation (SDC)
2. Ford Foundation

### Silvicultural characteristics of tree species to be considered before selection for plantation.

(Source field documents No 5 of UNDP/FAO project BGD/79/017-April 1985)

1. Nitrogen fixing ability
2. Soil $p^H$ tolerance
3. Cropping ability
4. Stem wood volume production
5. Above ground bio-mass production
6. Wood specific gravity
7. Calorific value
8. Susceptibility to grazing and browsing
9. Fire tolerance
10. Disease and pest susceptibility
11. Wind firmness etc.

# Programme on Energy, Environment, Resources, and Sustainability (PEERS) – 1997/98

## Final Project Report

# A study of sustainability issues in Joint Forest Management in Haryana

*Submitted by*
**Ms Shakuntla Jakhu**

**April 1998**

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*Conducted by:* Tata Energy Research Institute (TERI), New Delhi

*In collaboration with:*
United Nations University, Tokyo
Institute for Energy Technology (IFE), Norway
International Institute for Sustainable

*Supported by:*
Norwegian Agency for Development Corporation (NORAD)
Canadian International Development Agency (CIDA)

# A

# Study of Sustainability Issues

# in

# Joint Forest Management

# in

# Haryana.

by:-

**Mrs. Shakuntla Jakhu, IAS**

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Shakuntla Jakhu
IAS

# Table of Contents

**Chapter 1 Conceptualising Sustainable Development** ........ 1

1.1 Introduction ........ 1

- 1.1.1 Understanding Development ........ 1
- 1.1.2 Understanding Poverty and Underdevelopment ........ 2
- 1.1.3 Participatory Development ........ 4
- 1.1.4 Relationship between Environment and Poverty ........ 4
- 1.1.5 Defining Sustainable Development ........ 5
- 1.1.6 Understanding Sustainable Development ........ 6
- 1.1.7 Holistic Perspective of Sustainable Development ........ 7

**Chapter 2 The Birth and Growth of JFM in Haryana** ........ 8

2.1 Shivaliks Before JFM in Haryana ........ 8
2.2 Concept and Growth of JFM ........ 8
2.3 Institutional Implications of JFM ........ 9
2.4 Objectives of JFMP ........ 10
2.5 Strategies and Mechanisms ........ 11
2.6 Programme Facilitation and Implementation: TERI's Role ........ 11
2.7 TERI's Agenda for Transition ........ 13
2.8 TERI's Contribution to JFM ........ 13

**Chapter 3 Sustainability Issues in JFM** ........ 16

3.1 Equity and Socio-Economic Analysis of JFM villages ........ 16
3.2.1 Constraints to Sustainable Development ........ 17

- 3.2.2 Exclusion of Women from Decision Making ........ 18
- 3.2.3 Social Stratification and Domination of the Elites ........ 18
- 3.2.4 Domination of Elites in Decision making ........ 19
- 3.2.5 Domination of the Neo Elites ........ 20
- 3.2.6 Illiteracy in JFM villages ........ 20

3.2.7 Dependence on HFD & External Agency........21

3.2.8 The Panchayats and representation of Women........21

3.2.9 The Panchayats and HRMSs........22

3.2.10 Draft JFM Rules and Future of Benefit Sharing between People and HFD........23

3.2.11 Vertical and Horizontal Linkages........23

**Chapter 4 Strategy for Empowering JFM Villages for Sustainable Development**......24

4.1 Challenge of Designing an Empowering Strategy........24

- 4.1.1 Types of Empowering process........24
- 4.1.2 Stages of Empowering Process........25

4.2 Scope........25

4.3 Objectives........26

4.4 Features of Empowering Development Strategy........26

4.5 Role of Change Agent........26

- 4.5.1 Selection of Change Agents........27
- 4.5.2 Training of Change Agents........27
- 4.5.3 Selection of Trainers........28

4.6 Methodology........28

- 4.6.1 Instruments of Methodology........29
- 4.6.2 Development of Resource Material........29
- 4.6.3 Style and Approach of Intervention........31

4.7 Fecilitation of Awareness Generation........31

- 4.7.1 Group Formation........32

4.8 Proportionate Representation in MCs........33

4.9 Sensitization of Officials of HFD and Administrators........33

- 4.9.1 Restructuring SLWG/DLWGs and RLWGs........33
- 4.9.2 Agenda for SLWG........34

**Conclusion**........35

## CHAPTER 1

# Conceptualising Sustainable Development

## 1.1 Introduction

In the last three decades development scenario has been dominated by certain phrases like participatory development and sustainable development. These terms have acquired some kind of ambiguity having been interpreted differently. It is, therefore, necessary to understand these terms by conceptualising them. It would be worthwhile to make a mention of certain factors which inspired me to undertake the study of Sustainability Issues in JFM in Haryana. Having studied Rural Social Development at Masters' level from UK, having reviewed the practice of Participatory Development Projects and being a practitioner of development, I am aware of the difference in concepts and practice of development measures. It had been found that the difference was not only in the understanding of various terms at the time of conceptualising but also in the pronounced objectives and practice of those objectives. Therefore, before defining and studying sustainable development it is important to study the meaning, implications and experience of various paradigms of development in the last three decades.

### *1.1.1 Understanding Development*

**Before mid-Seventies Scenario**

The true meaning and nature of development must be defined for appreciation of issues like sustainability in development. The concept of development, however, has been given different interpretations. Before the mid-Seventies, development strategies were dominated by the top-down approach which concentrated on the transfer of physical goods to the poor. In this type of development strategies, people were treated as objects of development rather than being treated as active participants in development. Development had become 'capital centred' as opposed to 'people centred'. It had by-passed and marginalised people in its concern to build and construct. The impact of these modernisation development strategies showed that this approach was inadequate and suffered from a basic flaw in treating people as passive recepients of goods.

Policy planners and development thinkers, however, showed a disenchantment with this kind of development approach. It was acknowledged that the strategies aimed at economic growth have become instrumental in increasing the gap between the rich and the poor. Instead of self reliance and self esteem, these strategies resulted in passivity, dependence and deprivation as these failed to address the deep rooted causes of poverty.

Rahman said that

> "The tragedy of underdevelopment is not that the ordinary people have remained poor or are becoming poor, but that they have been inhibited from developing as humans. Elites have taken over the right to develop society and by this very act and claim have distorted the natural and profound popular notion of development. For no-one can develop others-one can only stretch or diminish others by trying to develop them."

This is an indication of the fundamental shift away from the domination of the modernisation paradigm of development. In 1983 Robert Chambers studied the impact of existing development strategies and rejected them as they had marginalised the poor. His statement that "the extremes of rural poverty in the Third World are an outrage" reflected the failure of the development strategies to improve the lot of the poor.

### *1.1.2 Understanding Poverty & Underdevelopment*

A development strategy can only be successful if the extent and nature of the problem is well understood. It was felt that the dimensions of poverty had not been perceived correctly in advocating the modernisation paradigm. Since poverty eradication has been acknowledged as an indispensable task for attaining sustainable development it is imperative to understand the dimensions of poverty so that suitable strategies for its eradication can be developed.

There was thus a remarkable effort in understanding the phenomenon of poverty. The features of poverty were identified and it was seen not in isolation but in total environment wherein social, economic, political and cultural factors operated. Freire (1972) wrote about "the culture of silence" and explained the complex scene of underdevelopment by saying that "rural people had no voice, no access and no participation in development activities". Schumacher (1973) argued that development did not start with physical goods but "with people and their education, organisation and discipline. Without these three,.all resources remained latent, untapped potential". It came to be emphasised that poverty is not just a lack of physical resources for development but was also a state of mind. Illich (1969) elaborated that underdevelopment was not only physical impoverishment but also a state of mind. It was emphasised that understanding it as a state of mind or as a level of consciousness was critical in bringing about change. There was, thus, a need for understanding the powerful contextual barriers which perpetuate people's isolation or lack of involvement in development. It was emphasised that instead of understanding poverty at a superficial level, it should be traced to its deep rooted causes.

Peter Oakley (1991) defined poverty as under:

> "Poverty is not just a lack of physical resources for development; it also implies powerlessness or the inability to exert influence upon the forces which shape one's livelihood".

The powerful, multi-dimentional and anti participatory forces dominate the lives of rural people. Rural people are "weak, isolated, vulnerable and powerless". Chambers (1983) studied the phenomenon of powerlessness and concluded that the poor people are caught in a cluster of disadvantages which interlocked and led to one another. He described the 'Deprivation Trap' and concluded that powerlessness, vulnerability, physical weakness, poverty and isolation were inter-related and reinforced each other.

Hence the **key features of Poverty and underdevelopment** can be described as under :

- self depreciation
- passivity
- acceptance of powerlessness
- belief in the 'invulnerability' of the powerful (Freire, 1972)
- isolation
- dependence

The phenomenon of poverty was further complicated by delivery system of inputs upon which the development strategies had been emphasising. The delivery system of inputs included a loan component alongwith a subsidy component. While the subsidy portion reached the poor in piecemeal, in some cases the loans were either misutilised or the whole package was not economically viable. This resulted in making the poor people defaulters in the repayment of loan to the bank. In other words, the poor people had no control on the forces of delivery system which became instrumental in their further impoverishment. The restlessness caused due to the failure of these development strategies compelled the researchers and development thinkers to seek alternate development strategies vigorously.

## *1.1.3 Participatory Development*

### Definition

Participatory development has been interpreted differently. Some have defined participation as contribution, others have seen participation as an empowering process.

Pearse and Stiefel (1989) have defined participation as under :

> "Participation is concerned with ..... The organised efforts to increase control over resources and regulative institutions in given social situations on the part of groups and movements of those hitherto excluded from such control".

Undoubtedly, the new understanding of poverty and underdevelopment in its overall social, political, cultural and economic complexities helped in giving rise to a new measure of development which can be broadly defined as being 'people centred' rather than 'capital centred'. The whole development agenda of the world was re-negotiated in the mid Seventies and new development paradigm with the name of 'Participatory Development' emerged. These strategies treat people as active participants of development and stress upon identifying the development needs of people by involving them actively in the development process.

The main **features of participation as empowering** are as under :

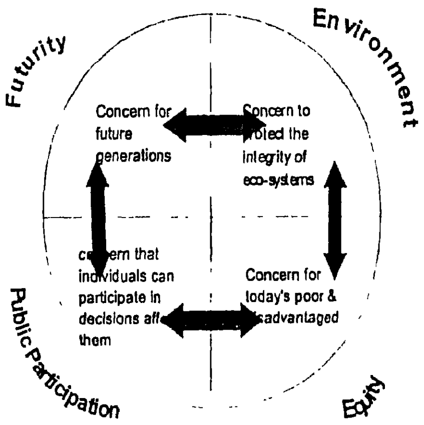
- building self confidence
- active participation
- rejection of powerlessness
- analysis of situation/ ability to question exploitation
- awareness of his/her rights
- self reliance

## *1.1.4 Relationship between Environment and Poverty*

As a matter of fact, concern for sustainable development has emerged due to the growing realisation that the earlier measure of development had ignored the sustainability aspects. Research analysts believe that the environmental issues in developing countries cannot be resolved without alleviating poverty and call for redistribution of wealth and income spatially, both within countries and between the rich and poor nations.

### *1.1.5 Defining Sustainable Development*

'Sustainable Development' and 'Sustainability' have been defined differently and there is no consensus about their definition. In 1987, the World Commission on Environment and Development (WCED) had defined Sustainable Development as "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Since the Brundtland Report's emphasis on inter-generational inheritance, Sustainable Development has come to include other components. Mitchell (1995) identified following principles underlying sustainable development:


Futurity
Environment
Concern for future generations
Concern to protect the integrity of eco-systems
Concern that individuals can participate in decisions affecting them
Concern for today's poor & disadvantaged
Public Participation
Equity

The principles underlying sustainable development
(adapted from Cooper, 1995)

In view of the "holistic nature of sustainability issues, these principles are very closely interlinked" (Gordon Mitchell *et al*).

It would be worthwhile for the purposes of this study to discuss these components one by one for having a better comprehension of the nature of sustainable development.

**Futurity**

Futurity implies that present generation should leave to the future the ability to maintain present standards of living.

### Environment

Sustainable economic development requires :

(i) Sustainable ecological systems on which economic production is based.

(ii) Sustainable patterns of economic exchange.

(iii) Sustainable utilisation of species and eco-systems.

The Rio declaration in principle 4 has stated that 'environmental protection is an inherent part of the development process', implying perhaps that development that does not protect the environment is not sustainable.

### Equity

Equity refers to the social aspects of sustainability. It essentially means equality of access to the world's global resources. The Rio Declaration has acknowledged 'eradicating poverty' as an indispensable requirement for sustainable development. The WCED definition of sustainable development has two aspects. First, equity for people living now, who do not have access to natural resources or social and economic goods; and the second, intergenerational equity.

### Public Participation

This has emerged out of the realisation that no development endeavour can be successful without people being active participants in it. The Rio Declaration on Environment and Development (UNCED, 1992) in Principle 10 stated that:

> "Environmental issues are best handled with the participation of all concerned. Citizens..... Each individual should have..... (information), and the opportunity to participate in decision making process".

## *1.1.6 Understanding Sustainable Development*

The term 'Sustainable Development' originally referred to pinpoint the (sometimes conflicting) objectives of economic development and environmental production. David Pearce (1989) believed that Sustainable Development as currently defined contradicted sustainable existence. It is obvious that in current usage, Sustainability and Sustainable

Development are "fuzzy buzz words" (Palmer, *et al*). These have come to mean different things to different people. There is some ambiguity about the dimensions of sustainable development. For instance, futurity, being an integral part of sustainable development has rarely been given a time-frame. There are also notions like strong and weak sustainability, which in fact refer to sharp division in perspectives of sustainability. Daly and Cobb (1989) differentiated between strong and weak sustainability ethics. Strong sustainability ethics dictate that a Society is only sustainable if equality of life is equally distributed among all people, and if the biosphere is not over exploited by people as a resource. The weak sustainability, on the other hand, excludes resource degradation and inter-generational equity. In other words, it is concerned only with environment principle of sustainable development. Weak sustainability has greater faith in technology for providing solution.

### *1.1.7 Holistic Perspective Of Sustainable Development*

The analysis of concepts given above makes it evident that sustainable development should be understood in a holistic perspective with its dimensions of futurity, environment, equity and public participation. For achieving the goal of sustainable development the issues which are deeprooted causes of poverty must be addressed so that poverty can be eradicated. Leaving out any of the above aspects would diminish the scope of a sustainable development strategy. For having a successful development project, the ingredients of sustainability namely futurity, environment, equity, public participation have to be suitably integrated in it. However, it has been argued that social and organisational changes should precede and anticipate major technical change (Fancheus & O'Conner, 1995).

# CHAPTER 2

# The Birth and Growth of JFM in Haryana

## 2.1 Shivaliks Before Joint Forest Management (JFM) In Haryana

The foothills of the Himalayas viz. The Shivaliks are spread over the North India covering about 2 million hectares in the States of Punjab, Haryana and Himachal Pradesh. These Hills have a history of vegetation and could boast of a variety of flora and fauna. However, after the British occupation of Punjab, these forests were destroyed. New settlements in these hills led to the felling of forests for preparation of land for agriculture. Nomadic herdsmen brought large herds of cattle to the hills for grazing. Consequently, thick forests were gradually replaced by denuded hills. Soil erosion became quite common and the once perennial streams became seasonal torrents washing tons of sand and boulders down from the hills. Shivalks are now densely populated. Even before independence, the denudation of the Shivaliks had assumed alarming proportions and had become a matter of concern for the Forest Department due to soil erosion and general land degradation. The denudation of the Forests compelled the Forest Department to have an over protective attitude towards forest management which ultimately resulted in the exclusion of people from the Forest. The forests were closed to grazing. Obviously, the Forest Department had failed to recognise the relationship of the people with the forest.

## 2.2 Concept And Growth Of JFM

As a matter of fact inter-dependence of people and forest is a critical factor in the sustainability of Forest. This principle was demonstrated and widely recognised due to the successful regeneration of forest adjoining the Sukhomajri Village in the early 80s. The concept of 'Social Fencing' evolved in Sukhomajri in Pinjore Block of Haryana showed that change in the villagers' existing resource use pattern can be made more sustainable while ensuring greater livelihood security. Sukhomajri's Gujjar grazers were enabled to reduce their dependence permanently on unsustainable grazing in the delicate forested hills with the help of earthen rain water harvesting dams built in adjoining forest which provided irrigation to their small land holdings. The success of the Sukhomajri experiment, which essentially started as a soil conservation measure to save the Sukhna Lake of Chandigarh from excessive siltation, proved to be a great boon to the people of the Shivaliks as it led to a new approach to forest management. Instead of policing, the Haryana Forest Department (HFD) was compelled to have a partnership approach towards forest management. The Joint Forest Management (JFM) stemmed from the realization by the concerned officials that forest could not be protected from impoverished villagers, who are acutely dependent for their survival on forests and policing methods only led to the unsustainable exploitation of forest resources. The JFM was an endeavour to devise viable livelihood alternatives for the people to enable them to put a stop to such unsustainable forest exploitation. Instead of this, they were seen as major stakeholders in forest protection. The JFM has demonstrated successfully that degraded forest could be regenerated dramatically by acknowledging rather than denying peoples' dependence on forest for their immediate survival.

Encouraged by the results shown by the Sukhomajri experiment the Haryana Forest Department (HFD) adopted the participatory forest management approach for managing the degraded forests in the Shivalik hills. Government of Haryana (GOH) framed the JFM policy on 30th June, 1990 for management of state forests jointly by the HFD and the forest community users groups which were registered as Hill Resource Management Societies (HRMSs). The adoption of this approach was a landmark initiative for involvement of local community in the management of forest areas. This has shown remarkable results in regenerating these degraded forests and grass lands. However this gigantic task was accomplished by the concerted efforts of external support team, HFD and the GOH.

## 2.3 Institutional Implications Of JFM

The participatory Joint Forest Management Programme (JFMP) required a total reversal in the role of the Forest Department. Up-til now the HFD had been using power and authority and had no accountability whatsoever to the various dependent villagers. Moreover the new programme required a decentralised and responsive HFD instead of centralised top down approach adopted by the HFD so far. This involved a major shift in the approach towards the problem and it was radically different from the earlier approach. The JFMP required a flexible approach sensitive to the socio economic concerns and processes for nurturing and collaborating partnerships. Challenging reforms in the Forest Department's training, internal structure, priorities, orientation and decision making processes were required. Instead of adopting the authoritative and policing role, the HFD had to adopt a new role of a friend, guide and partner in managing the forests. These were entirely unfamiliar concepts for the HFD officials. The villagers were expected to play the role of protectors of the forests as their livelihood needs were dependent on the forest. They also had to be facilitated to adopt the new role to ensure that the grass root level institutions are evolved.

Tata Energy Research Institute (TERI) was approached to work as facilitator for bringing about the above mentioned changes not only amongst the people but also amongst the HFD. TERI's proposal titled National Joint Forest Management Support Centre-Haryana was funded by the Ford Foundation and had become operational from July 1,1990 for a period of three years upto 1993. TERI did an outstanding job in partnership with the people and the HFD and the programme was extended by introduction of second phase in July 1993 which ended in July 1996. A supplementary proposal to strengthen internal mechanism and capacity of HRMS for maintenance of water harvesting dams and associated water distribution and conveyance system was incorporated into this programme in July 1994. July 1990 thus marked the beginning of the process of institutionalisation of JFMP.

## 2.4 Objectives Of JFMP

The Project Proposal[1] submitted by TERI to the Ford Foundation has described the objectives of JFMP as under:

The primary objective of the Programme was systematic integration of JFM within the policies, programmes, procedures and operations of the HFD along with involvement of communities in the protection, conservation, regeneration and sustainable management of forest resources. The other objectives of the programme were -

- Development of participatory forest management systems for adoption by the HFD.
- Orientation of the forestry staff and local communities towards JPFM and their attitudinal/ operational transformation through grassroots meetings, training workshops, and extension activities.
- Institutional training and procedure development related consultation services to the HFD.
- Research on institutional, economic, ecological and socio-economic issues.

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[1] Project proposal on HFD-National Joint Forest Management Support Centre Haryana submitted to Ford Foundation New Delhi by TERI in October 1996.

- Dissemination of information concerning impacts of JPFM on ecological regeneration, economic productivity and environmental security through publications and workshops.
- Promote exchange of experiences through study visits, etc.

## 2.5 Strategies And Mechanisms

The Project Proposal of TERI has mentioned the following strategies and mechanism for implementing JFMP:

- Institution building through meetings, discussion and grassroots interactions with office bearers, society members and other disadvantaged groups.
- Capacity building through training, workshops, farmer's training camps and women's training workshops.
- Participation of societies in the management of fibre and fodder grass leases, bamboo forests, plantation and cleaning operations, microplanning, water harvesting dams and catchment treatment measures.

## 2.6 Programme Facilitation And Implementation: TERI's Role

TERI's Project Proposal has summed up its role in the implementation of JFMP as under:

A Joint Management Unit (JMU), comprising the JMU Coordinator, an officer of the rank of ACF, HFD field staff and TERI Resource Team, was established by the HFD at Pinjore for implementation and coordination of the programme; the broad areas of work of the JMU have been -

- Creation and establishment of the HRMS.
- Facilitation and development of a cordial working relationship between the HFD and the village communities.
- Detailed process documentation through field reports, village meetings reports, workshop proceedings and appraisals.
- Research and case studies on socio-economic, institutional, ecological and economic issues and impact assessment.
- Publicity and extension through newsletters, presentations, field tours and pamphlets.

A second JMU was later established at Yamunanagar in January, 1995 to cover the eastern region of Shivalik hills. One senior Resource Person from TERI has been permanently based at each of the two locations, to liaise with the HFD, and maintain a continuity in interactions with the HRMSs. In addition, a set of six Research Associates from TERI have been involved with the Programme, and they visit the sites on a regular basis.

A State Level Working Group (SLWG) was constituted as an apex decision making and policy formulation body for monitoring the development, and effective implementation of the JFMP. The group is convened by the Principal Chief Conservator of Forests (PCCF) with senior officers of the HFD, representatives of the Ford Foundation and the TERI Resource Team as members.

Two Divisional Level Working Groups (DLWG) have also been established for the Forest Divisions of Morni-Pinjore and Yamunanagar. The DLWG meetings are convened by the respective DFOs of the two divisions, and attended by the JMU Coordinator, the RFOs, and the TERI Resource Team. The constitution of the Range Level Working Group (RLWG) was in response to the need felt by the members of the DLWG and SLWG, for having forum for discussion of site-specific issues of direct concern to individual HRMSs. In order to facilitate implementation and monitoring of the Programme at the grassroots level and address specific issues emerging in each forest range during the course of implementation in the field, the RLWGs were established in 1994 under the convenorship of the RFO in each range, with representation from members of the HRMSs. The RLWG also acted as a filter for deciding on the agenda of the DLWG and the SLWG.

The Working Groups serve as an effective fora for discussion and resolution of issues, communication with a broader cross-section of people, and participative and/or consultative decision-making. The communication system thus established hastens the process of decision making and enable immediate corrective action where the project systems and impact are concerned.

Presently TERI is implementing third phase of JFMP which is a transitional phase. There has been consistent growth of the JFMP as is shown by the following table[2]

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TERI's Project Proposal on National Joint Forest Management Support Centre - Haryana submitted to Ford Foundation in October 1996.

**Age distribution of HRMSs**

| Period | Morni-Pinjore Division | Yamunanagar Division | Total |
|---|---|---|---|
| <2 years | 7 | 7 | 14 |
| 2-5 years | 7 | - | 7 |
| 5-10 years | 17 | 10 | 27 |
| >10 years | 8 | - | 8 |
| Total | 39 | 17 | 56 |

## 2.7 TERI's Agenda For The Transition (1996-98)

TERI's agenda for the transition is that of sustaining the JFMP through

- Maintenance of the momentum gained in the area of participatory resource management over the last one decade.
- Creation and establishment of a viable institution of HRMSs for sustenance of the Programme, and achievement of the broader objectives of JFM.
- Capacity building within the HFD for taking over responsibility of all aspects of the Programme.
- Facilitation of integration of participatory management systems within the regular functioning of the HFD.
- Creation of an enabling environment for expansion of the concept and practice of JFM to new areas.

## 2.8 TERI's Contribution To JFM

TERIs involvement with the JFMP since 1990 has acquired new proportions in the nature as well as scope of activities. Analysis of TERI's work shows a remarkable mprovement in the programme. TERI has added new dimensions to the JFMP by addressing specific gender related issues. The focus on training has also shifted/ broadened from orientation and skill building workshops on JFM to more need based and technical training on base line vegetation survey and construction and management aspects of water harvesting tructure. The present programme of TERI involvement will come to an end in December

1998 when TERI aim to withdraw from the scene of JFM in Haryana. A brief analysis of JFMPs achievements can be traced as under:

- Creating institutional framework at various levels. The creation of Hill Resource Management Societies (HRMSs) is a remarkable achievement as it provides a forum to the villagers to participate in the JFMP as partners in social fencing with the HFD. A study of the formation of the HRMSs in the Shivalik region in Haryana indicates the growth of grass root level bodies. It was a process of learning while doing and the membership of HRMSs were thrown open to all adult men and women after it was realised that HRMSs were not really representative while keeping membership open for heads of household. The involvement of the people in HRMS and the growth of HRMS indicates that the support team and the HFD were able to penetrate at the village level and were able to create a forum for people's participation. The Managing Committee (MC) of the HRMSs were formulated to take quick decisions. Later, women were also represented on the Managing Committee (MCs) to look after the gender interest.
- TERI was able to facilitate and develop cordial working relationship between the HFD and the village community. The process of participation and involvement of people was documented by doing field studies and keeping records of village meetings and workshops. These records are appraised for further action. Research and case studies of socio-economic, ecological and institutional issues and impact assessment are a continuous process. The JFMP is being publicised by newsletter publication, field tours and pamphlets.
- TERI has been able to create a four tier institutional structure which has provided appropriate/adequate fora for programme implementation and monitoring.
- TERI has worked for systems integration through formulation so that the administrative information and monitoring of JFMP gets integrated with micro plans and other forestry related operations of regular departmental working. TERI has been providing back up support for operationalising linkages between JMU, HFD and the Working Group (WG), regularisation of functioning of the WG, re-organisation of the administrative structure for facilitating the JFMP and for participatory forestry operations.

- With the help of TERI team and HFD, the HRMSs are learning the management of fodder and Bhabbar grass leases.
- The Haryana Joint Management Forest Areas Rules have been drafted for giving legal sanctity to the people-HFD partnership established under the programme.
- The setting up of a Kalyan Kosh (Welfare Fund) would boost JFM related activities.
- Most remarkable achievement of JFMP is the regeneration of forest on the hills which were lying barren and denuded. These hills now look green with various trees growing on them and the crucial link between the people and the forest has again been re-established which acknowledges the relationship of their mutual dependence. The subtle mechanism of this entire dependence is evolving well under the JFM Programme. People are generally able to operationalise the programme through the Managing Committees and HRMSs with the assistance and support of TERI and HFD. JFMP has succeeded in giving tangible results by way of regeneration of forest and by way of establishment of trust and inter-dependence of the HFD and the people for regeneration and maintenance of forest.

## CHAPTER 3

# Sustainability Issues In JFM

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## 3.1 Equity And Socio Economic Analysis Of JFM Villages

The External Support Team and HFD had the mandate of starting a new partnership between the people and HFD, and to strive to initiate long term relationship of inter-dependence by adopting the principle of social fencing. JFM has brought the villagers in the fold of development by establishing partnerships of mutual trust between themselves and HFD. People's participation as a crucial contribution has been achieved in JFM. However even though so much has been achieved much remains. The challenge before JFM today is to ensure the equitable distribution of resources generated through JFM and to ensure that the programme becomes sustainable. The equity factor is crucial in cementing the relationship between the people themselves and with the HFD.

HRMS village societies are marked by social and economic differentiation. There are disparities on the basis of caste, gender and religion. Therefore, it is necessary to be aware of this complex relationship and formulate a mechanism which looks after the equity principle and the village level institutions like HRMSs and MCs are proportionately represented by the deprived communities and women. This task is easier said than done. The HFD and external support team have endeavoured to include women and deprived sections in the MCs and HRMSs. However, it is important to note that making them members of HRMSs and MCs is only the first step and it does not ensure their active participation in these bodies. As a matter of fact, it must be acknowledged that the dominant caste, gender, social and religious groups dominate the decision making at the village level bodies. The deprived sections and women have accepted the dominant role of such groups and either do not feel the necessity or have no courage to question their decisions. In other words, there is what Freire (1972) calls a 'magical force of reality' and 'the culture of silence' prevails among the rural poor. The different kinds of disparities and power structures continue in the villages unabated and it would be too simplistic a solution to suggest that any programme can eliminate these differentiations altogether.

Even though equity related issues have been raised by the support team, no easy solutions are available. Still, strategic decisions in the formation of HRMSs, MCs, RLWGs, DLWGs and SLWG can be taken by giving these deprived sections a proportionate representation. JFMP ensured the participation of women by getting at least two women nominated on the MCs by making it a rule. The study of the gender issues in the JFMP areas has revealed that even though women are made members of General Body and MC, they are still not consulted. In Village Dhamala, during training, the lone woman member of MC refused to accompany the male team in the unpleasant task of collecting pending dues from HRMS members and protested that she had never been consulted/informed about the HRMS's decisions. Sarin (1996) has mentioned about learning through process monitoring and documentation. She has studied the implications of the rule of making only two women members of MCs. It was found that the representation of more than two women members on MCs was denied by the HFD in their enthusiasm to implement the rule even in cases related to all women activity of basket making in village Bar Godam. Alienation of women from community functions and decision making is a long story and cannot be wished away as it requires a detailed and thorough sensitization of HFD officials as well as the villagers. The primary mandate of the major institutions involved in implementing JFM Programme viz., TERI and the HFD was improved forest management.

A sustainable development project should have people's participation on equitable basis so that the fruits of development get equitably distributed. However, such ambitious objectives like people's participation and equity cannot be achieved in a short timeframe simply because they cannot demolish the existing power structures operating in the villages. Even if a project with a given time-frame is designed to break these barriers and empower the village people with the objective of their active participation, tangible results may not be achieved in a short timeframe. However, such projects can be successful in initiating a process whereby the excluded deprived sections of society can gradually come under the fold of development endeavours.

### 3.2.1 Contraints to Sustainable Development

Although, the TERI and HFD have given a concrete shape to the JFM programme, the following constraints threaten its sustainability on counts of equity.

### 3.2.2 Exclusion of women from decision making

An analysis of the functioning of HRMSs shows that although the villagers are participating in the forest management, a large number of them are not vocal and active participants. In a study of the programme, Sarin (1996) has quoted many instances of a majority of deprived sections remaining silent spectators in the HRMSs. The example is of the Bhanjda Bamboo basket makers in BarGodam in Kalka, where the occupation of basket making is exclusively being handled by women with only a few exceptions. It became evident that "woman's important role in basket production was barely reflected in their representation on the Management Committee (MC) of the HRMS. In a nine member MC, there were only two women members. Similarly, when the Kalka HRMS was formed, out of 14 existing permitholders, 10 were women. Out of 19 applications for HRMS membership, as many as 4 were by widows who were effectively heads of their households but even here, only two women were represented in an 11 members MC". The case of Kalka MC was the soundest case where there could have been an all women members HRMS. In fact, the harsh reality must be accepted that with any male dominated society especially at the village level, it is hard to improve the comprehension of gender issues. It would be worthwhile to study the sex ratio in Haryana. The 1991 census had revealed the sex ratio of 872 in Haryana which was the lowest in the country. Within the State, the sex ratio varies between 813 to 931 across the districts of the State with an average of 865 females per one thousand males. Sex ratios are equally adverse in almost all the HRMS villages. The average sex ratio of HRMS villages is 824 which is even less than the average sex ratio of the State[3]. The masculine character of the population reveals the whole complex of socio cultural attitudes, beliefs, privileges and values unfavourable towards women dominating the family and community life.

### 3.2.3 Social Stratification And Domination Of The Elites

The social stratification is characterised by the caste factor in India. Commonly found castes in HRMS areas are Banjare, Bhanjadas, Brahmin, Gujjar, Jat, Lohar, Labane, Nai,

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[3] Joint Forest Management: Evolution of Community State Partnership in the Rehabilitation of Haryana Shivaliks. TERI's book under publication.

Ramdasia, Rajput and Balmiki. Among these, Bhanjadas, Gujjars, Lonar, Nai, Ramdasia and Balmiki belong to the lower castes. The most dominating caste of the HRMS area is Gujjar followed by Jat, Ramdasia, Banjare and others. The number of upper castes like Brahmins, Jats and Rajputs are insignificant in number accounting for approximately 20% of the total families of the area. The HRMS societies are heterogeneous in character and it is difficult to formulate groups of homogenous nature in such societies.

### *3.2.4 Domination of Elites in Decision making*

In decision making process, the so called higher castes who are generally economically sound play a decisive role, even today. This has been happening since long and the centuries of exclusion of the deprived sections of society including women has conditioned them not to question the decisions taken by the dominant persons of the village. It has been observed that unless the impoverished state of mind of the poor is attacked and they are empowered by giving them means both economic and mental, the system of exploitation will not cease. It is important to understand how the power structure at the village level operates. On the one hand, the deprived sections, bereft of economic power, self-esteem and rights, live at the subsistence level, on the other hand, the powerful equipped with economic, social and political power are used to exercising uninterrupted and unquestioned authority. The short-term intervention of external agency and HFD cannot break the deep rooted barriers in a highly stratified society. It has been noticed that the resource generation due to regenerated minor forest produce called Bhabbar grass may give rise to new patterns of exploitation to the already powerful people. For example, in Bar Godam, 31 families of Bhandja community are very poor. They make baskets out of bamboo. It was noticed that the Sarpanch used to charge Rs. 10/- per person per month for getting them permits of bamboo cutting from the Forest Department. When it came to the notice of HFD, they introduced a system of delivering the permits through the Forest Guard direct to the permit holders. The Bhandja basket makers feel trapped in the debt trap as they have to market their basket through the age-old money lender from whom they had taken loan.

### 3.2.5 Domination Of The Neo Elites

The functioning of MCs and the HRMSs has revealed the potential danger of exploitation by the members of the MCs. Instances have come to the notice where the MC members overreached themselves and acted much beyond their mandate. In village Thaska of Yamunanagar the President of the MC unauthorisedly withdrew an amount of Rs.20,000/- from the HRMS funds. On being exposed there was pressure on him to return the money of the society. This however illustrate as to how poor members of the HRMS are unable to hold the members of the MC accountable. As a matter of fact the so called new leaders of the poor tend to exploit them. Freire (1972) has mentioned that "Yesterday's oppressed have become today's oppressor's". He has further stated that "almost always during the initial stage of struggle, the oppressed, instead of striving for liberation, tend themselves to become oppressors, or 'sub oppressors' " Freire has analyzed the reasons of this attitude of the leaders of the poor. The sub oppressors "having internalized the image of oppressor" behave like them only. To my mind this also happens because of the knowledge that the poor are unable to check them due to their exclusion and powerlessness.

### 3.2.6 Illiteracy In JFM Villages

The poor literacy level of HRMS villages has also contributed significantly to their powerlessness and inability. The hilly track of the Shivaliks hills in Haryana cannot boast of well spread facilities of education because of the physical difficulty of hills. Most of the school teachers try to avoid posting in this area which further complicates the issue of increasing the literacy level of this area. Besides, the area is characterized by the absence of literacy drive. There are no efforts to informally educate the adults in the villages. The area is marked by the absence of an NGO. Obviously the illiteracy is a major stumbling block in making participatory development endeavour effective as the poor illiterate are unable to hold the MCs accountable. Sarin (1996) found in her study that instead of "participatory democracy" the HRMSs are characterized by "representative democracy". Even though achievement of representative democracy at this stage is not a small achievement, it indicates that the continuance of this would harm the equity of benefits.

### *3.2.7 Dependence on HFD and External Agency*

Conflicts caused due to various reasons including the reasons mentioned above were resolved by the members of HFD and the external agency in the HRMS villages. The HFD has a team of male members with only a few exceptions. Besides the attitude of the Foresters earlier had been authoritative and commanding . It is very difficult to bring about attitudinal change in the staff of the HFD and even though some Foresters were sensitized the problem of sensitizing others surfaced when they were transferred from the HRMS area. Instances have come to the notice that some of the Forest officers in their enthusiasm overreached themselves and found it hard to allow people to take their own decisions on the basis of their knowledge. Sarin (1996) has mentioned that HFDs approach in JFMP was "more directive rather than facilitative".

### *3.2.8 The Panchayats and representation of women and scheduled castes*

The Haryana Panchayati Raj Act, 1994 has aimed at empowering the Panchayats. The Act has also given representation to women and scheduled castes in the Gram Panchayats. Due representation has also been given to women and scheduled caste for the post of Sarpanch. The constitution of Gram Pachayats in Haryana after the enactment of the Haryana Panchayati Raj Act, 1994, presented an interesting phenomenon. In a meeting of the Sarpanches called by Deputy Commissioner, Ambala the spouses of these women Sarpanches presented themselves in the meeting before the Deputy Commissioner. On being asked where the women Sarpanches were, they informed that they are Sarpanches and that the women were sitting outside the Deputy Commissioner's office. On the insistence of the Deputy Commissioner, the lady Sarpanches were called inside and the husbands were asked to sit outside so that the lady Sarpanches could participate in the meeting.

The data collected from the 17 HRMSs of Yamuna Nagar Forest Division, has revealed that 7 women have become Sarpanches in place of the Male Sarpanches in the 7 HRMS villages as a consequence of the enactment of Haryana Panchayati Raj Act, 1994. Although Rehmati Devi and Hasina Begum have become Sarpanches in village Nagli and Darpur, in place of their family members viz. fathers-in-law, it has been revealed that the power of the Sarpanches are practically being exercised by the fathers-in-law. These women

Sarpanches are obliged to put their thumb impression whenever and wherever asked by the father-in-law. The data of these HRMSs has indicated that the women Sarpanches generally belong to the traditionally powerful families. Generally, in the villages members of two or more powerful families keep getting elected as Sarpanches. This is indicative of the power structure operating at the village level. The new Act, however, has ensured the election of the scheduled castes and women to the Panchayats as Panches and Sarpanches. With two exceptions, the forest in the JFM villages have been raised on the Forest land. The empowering of the Panchayats under the new Act thus may not give rise to any direct conflict. On the other hand the increased representation to the deprived sections like women and scheduled castes will prove a significant step in giving them representation on these statutory bodies. The interests of the poorer sections of society will be safeguarded on the forum of Panchayats. The illiteracy of these representatives, however, is a major bottleneck in their effective functioning as members of Panchayat or Sarpanches and in truly representing the interest of their communities.

### *3.2.9 The Panchayats and HRMSs*

Whereas the Panchayats have legal support being statutory bodies, the HRMSs have no legal sanctity. In fact the Panchayats in the HRMS villages, with a few exceptions hardly have any source of income. Ultimately the HRMSs have to coexist with the Panchayats at the village level. Even now while the Panchayats of HRMS villages do not have funds, the HRMSs are able to raise funds from the leases of Bhabbar grass on annual basis. Presently there is no conflict in the coexistence of HRMSs and the Panchayats. However, there are potential areas of conflict between the HRMSs and the Panchayats keeping in view the resource generation and the fact that even now the Panchyat leadership is characterized by the dominant families of the villages. The power struggle between these two institutions can be mitigated by enabling the HRMSs. This is a difficult task as it involves gradual capacitation of the poor.

### 3.2.10 Draft JFM Rules and Future of Benefit sharing between people and HFD

The benefit sharing between the people and the HFD has not been given a legal support till now. Presently the benefit sharing is limited to water harvesting from dams, leases of Bhabbar grass, Bamboo basket making etc. However the forest trees have also been planted in partnership with HRMSs by the HFD. As per the present understanding the sale proceeds of these expensive forest trees would also be shared between the people and the HFD. The strength of JFMP lies in this benefit sharing for cementing the long term relationship of the people and the HFD. The income from the sale of forest trees in the JFM areas would be phenomenal which means that the HRMSs would get lot of funds in keeping with their share from the sale proceeds of the forest trees. Since the benefit sharing pattern has not been approved by the government of Haryana this may give rise to conflicts later on. More delay in getting the JFM Rules approved from the government will make it more difficult for the Rules to be approved as the stakes of government in forest would increase with the maturity of forest trees. The very fact that the JFMP Draft Rules are hanging fire for the last seven years puts a question mark on the sustainability of the JFMP.

### 3.2.11 Vertical and Horizontal Linkages

A forum of the HRMSs is necessitated so that by organizing themselves they are able to ensure that their interests are looked after. This would also ensure the resolution of matters like repair and maintenance of dams and integration of the Micro Plans of the villages in the Working Plans of the HFD. However, this is a time consuming process and there is a need for intervention in this area.

While JFM has achieved equity of access, the equity of benefits is yet to be achieved. For a sustainable forest development endeavour, all sections of societies should get equitable distribution of the benefits arising out of the joint management. When the larger sections of society have accepted their role as silent spectators and have resigned to accepting the decisions taken by the dominant groups, how is it possible to ensure equitable distribution of the benefits once the external agency withdraws ? Sarin has advocated "Search for more effective programme strategy, as well as the rational basis for main streaming women in JFM."

# CHAPTER 4

# Strategy For Empowering JFM Villages For Sustainable Development

## 4.1 Challenge Of Designing An Empowering Strategy

One of the objectives of this assignment is to devise a suitable strategy for empowering the JFM villages for the purposes of sustainable development. A critical analysis of the status of JFMP in the JFM villages has clearly indicated that there is a need for further intervention. The JFM members are dependent on the TERI and HFD for the implementation of JFMP and they are not self-reliant enough at this stage to take command of JFMP.

It has been acknowledged that it is difficult to design and implement a genuine participatory development strategy. "How to turn such a project around is the major challenge. The emerging practice to date has suggested that key elements in development projects will need to be re-examined; the more difficult task is to incorporate these elements more particularly into project practice" (Oakley, 1991). The strategy would concentrate on **participation as a process of empowering**. "Participation as a process evolves through a series of stages and through a combination of different elements" (Oakley, 1991). The project would have a mix of economic activity (which, in the present case, is already available) and the ability to participate in the benefit sharing.

An outstanding feature of this development strategy is **emphasis on empowering the poor people by helping them in changing their state of mind**. This emphasis is critical in changing the scene from powerlessness to power. However, this is a daunting task. This Development strategy is not a one time activity but it gives rise to a process whereby focusing on awareness generation leads to a development process in which people become active participants of the development endeavour.

### *4.1.1 Types Of Empowering Interventions*

The **process of empowering** villagers consists of **two types of interventions.**

(a) Taking strategic decisions for providing institutional framework and ensuring people's access to that for representing their interests at various levels. For instance, the amendment in the Haryana Panchayati Raj Act 1994 has ensured the representation of women and scheduled castes in Panchayats as Panches and Sarpanches.

(b) The second intervention is initiating a process of change. The very word 'Change' involves rejection of the present status. Since sustainable participation is a long drawn process, it requires a long gestation period. Empowering consists of change at two levels; change within and change in the outside situation in the shape of income generating activity. Under the JFMP, change outside in the shape of regenerated forest has taken place which was the primary mandate of the programme. The change within the mind is initiating a process of empowering for which the present strategy of intervention is required.

### *4.1.2 Stages Of Empowering Process*

The process of empowering the poor and deprived unfolds in various stages which may be described as under :

- analysis of situation of exploitation
- tracing the root causes of exploitation
- rejecting the exploitative process
- self confidence
- enabling/ capacitating
- active participation
- self reliance
- struggle for exercising rights to get a share in power
- deprived poor people's slow access to the means of power by getting increased control over the factors which control their lives.

## 4.2 Scope

The scope of this strategy is to make the HRMS members self-reliant by empowering them. This is much beyond the mandate of the JFMP uptil now which was limited to forest management and establishing suitable mechanism between the people and HFD. The new strategy would aim at **overall development** of the people by taking a **holistic** view.

## 4.3 Objectives

- remove mental impoverishment of the deprived people including women
- reduce their dependence on HFD
- reduce their dependence on external agency
- balance between economic activity and people
- emphasis on gender development
- shift in focus from HFD/External Agency to HRMSs
- improve literacy levels of deprived classes including women
- self reliance of poor people including women
- self reliance of HRMSs
- enabling people and HRMSs to organize and negotiate power for exercising their rights at various levels

## 4.4 Main Featuresof An Empowering Development Strategy

The main feature of this empowering development strategy would be as under:-

- long term as opposed to short term
- autonomy as opposed to control
- structural analysis of the context as opposed to the physical understanding of immediate problem
- spontaneity as opposed to fixed objectives
- local actions as opposed to local response

## 4.5 Role Of Change Agents

The most outstanding feature of the strategy would be the role of the Change Agent. The strategy would strive to have a different kind of Change Agents. Tilakratna (1985) has elaborated the following skills of the Change Agents:-

- a scientific method of social analysis and study;
- an ability for continuous learning;

- two-way horizontal communications;
- facilitation;
- ability to cope with tension and conflicting situations;
- ability to adjust to the life and work styles of rural people;
- ability to make himself/herself redundant to the participatory process

### *4.5.1 Selection Of Change Agents*

Even the selection of the Change Agents would be of crucial importance. In selection their social background, commitment for upliftment of the poor and experience in empowering, if any, would be given importance. The Change Agents do not have to be elite and white collared persons. instead they would be sons of the soil/ daughters of the land who are well versed with social realities. There would a good mix of expertise in forestry, social and gender issues in the selection of the team of Change Agents. Tilakratna (1985) has emphasised the social background of Change Agents and the importance of the selection of most suitable Change Agents. This is crucial as the change agent will have to play the role of a catalyst in the empowering process.

### *4.5.2 Training Of Change Agents*

The Change Agents would be sensitized to have the above mentioned skills. The trainers of the Change Agents would be selected with great care keeping in view their orientation, background and experience of awareness generation in like programmes. The Change Agents will be sensitized by experts in gender about the factors which inhibit women's participation in the JFM area. They will be readied to face the challenge of changing cultural attitudes, norms and traditions which have excluded women from societal decision making for centuries. They will have to stay in the villages to earn the trust of the villagers. In the work of facilitation and sensitization the conduct and commitment of facilitator or the Change Agent is of critical importance. For instance if the facilitator or the Change Agent gets hospitality of the prominent families in the villages he/she may alienate himself/herself from the poor people. The Change Agents must have the capacity for "a progressive redundancy" (Oakley, 1991). The change agents will strive at self reliance of people. For this purpose people could be encouraged to call meetings, decide venue and time of meetings, conduct the meetings, etc.

### 4.5.3 Selection Of Trainers

Selection of trainers of the change agents has to be done with care and keeping in view the objectives of this strategy. It must be remembered that our attitudes are conditioned and we get dictated by various biases. Chamber (1983) talks about a number of biases. These biases have to be abandoned. There is a need for deconditioning the project managers so that they are ready to come to grips with the ground reality. Selection of right kind of trainers is thus at the cutting edge in this project. Fortunately, India has the proud privilege of pioneer work in the training of trainers in the empowering process. Bhasin's (1985) documentation of methodology and style of intervention can guide the project managers in this respect.

## 4.6 Methodology

After examining a number of participatory projects of various countries. Peter Oakley (1991) concluded that "Methodology is important to the practice of participation since, as a process, it cannot be expected to emerge like a plant within a fixed period of time". Oakley has stated that "Participation is not an objective which can be achieved by the periodic maneuvering of project staff and resources, it must, in conjunction with local people, be carefully thought out and its development carefully nurtured".

In the strategy of participatory and sustainable development, emphasis would be given to the process of participation instead of seeking quantitative results. The strategy would emphasize on building a local base in facilitating organisation of people in cohesive groups. Rehman (1989) had argued that the process of participation must unfold in rhythm with the pace of the life of the people involved. For successful intervention of the programme, a team of change agents would consist of multi-disciplinary backgrounds having a combination of forestry, gender and social activism so that the process of participation unfolds in the right direction.

### 4.6.1 Instruments Of Methodology

The traditional and formal methods of communication create distance between the fecilitator and the people. The objectives of this strategy cannot be achieved with formal methodology. Instruments of methodology refer to the mechanisms whereby the stages of Methodology can be successfully completed. Some of the instruments of participatory methodology are given as under:

- project group meetings and discussions
- popular theater and street theatre
- songs
- workshops, seminars and camps
- small group media like Video, Puppetry, Sound Slide Production
- Poster making and cartoons
- informal literacy classes

These instruments of methodology would be based on participatory principles. Instead of sitting on the pedestal, the Change Agents would be required to sit with the people. This methodology is new and distinctive, matching with the performance of objective of the strategy.

### 4.6.2 Development Of Resource Material

Resource material for empowering the people needs to be developed by the project managers keeping in view the socio economic, gender, language and environmental status of the JFM area. Fortunately a lot of work in this area has been done in South Asia and in India. For example, for incorporating the gender sensitization and poverty sensitization in the school curriculum National Council for Educational Research and Training (NCERT) has developed excellent resource material. The curriculum of schools has been developed accordingly so that the spirit of 'Action for women's Equality' envisaged in the Programme of Education of the National Education Policy, 1992 can be translated into practice. This curriculum has been designed to focus on the structural, socio economic and gender issues by raising these issues with the help of short stories, plays and poems, etc. Through stories, songs and plays the message is unfolded in an interesting manner. In the end of the Chapter, there is a series of questions which, if answered properly will lead to the awareness generation of students. These are designed to sharpen the analytic abilities of students and raise the consciousness level of the reader as his/her mind is made to think about the deeper issues raised through the medium of short stories and plays.

Here it would be worthwhile to point out the important role of the teacher. If the teacher is still conditioned to think in the old way and has not been sensitized, the danger of passing old conditioned attitudes to the students would remain. Hence it is of utmost importance to sensitize the teachers.

Being a practitioner of development I had devised capsule courses of short duration for college lectures of Haryana State while I was Director of Higher Education for about 4 years. I had been able to bank upon a large variety of resource material which has been developed not only in the shape of written material but also as audiovisual material like cassettes of songs. Here it may be mentioned that after initial hesitation, the college lectures themselves became involved in the programme of sensitization and we were able to cover 3500 college lecturers out of a total of 5200 in the state. A series of Workshops, seminars and informal interactions proved very helpful in raising the awareness level of teachers about gender, socio-economic dimensions of poverty and the role of teacher in this area. For sensitizing the teachers the expertise of NGOs and practitioners in various areas were sought. It may be mentioned that Haryana was the only State to start this kind of sensitization programmes and the need of this intervention was felt by me because of my orientation and sensitization about these issues. It must be admitted that my background of having worked on participatory/ empowering development during the course of doing Masters in Rural Social Development from UK was instrumental in changing my orientation and in deconditioning my conditioned attitudes. This highlights the need of sensitization of all project managers.

The designing of the course has to be done by an expert in the field of empowering. This must be remembered that this project has a different objective hence its design has to be in keeping with the objectives.

### 4.6.3 *Style And Approach Of Intervention*

The empowering process is not a one time activity but it continues over a long period. The initiation of empowering process requires an entirely different style of intervention. The facilitators for this process have to be specially trained. This calls for a different kind of education through a dialogical approach as against the prevalent approach which Freire calls the 'banking' approach. Chambers (1983) has studied the implications of the new style of intervention. It demands reversals of various kinds and at various levels. The personal implications of this style for fecilitator is reducing his role gradually. The project design, the methodology, the resource material require reversals of the existing practice. It requires unlearning on the part of project managers as well. This approach facilitates process of bringing about change in the thinking of the village people. Instead of providing answers and directing solutions, the change agent helps the villagers to analyse the immediate surroundings and their problems. By rejecting the status-quo the villagers gradually become aware of their rights and adopt the role of active participants in development. The awareness generation of the people leads to long term process of change which further leads to sustainable relationships in the development endeavour.

## 4.7 Facilitation Of Awareness Generation

It has been observed that those sections of Society which have been deprived of participation in the societal functions for a very long time have an inhibition and hesitation in participating. The Change Agent or the Facilitators would initiate intervention in an informal way trying to be a part of the villagers themselves. The instruments of methodology of awareness generation mentioned above will be based on the real life situations having direct relevance with the life of the rural people. These would have messages pertaining to social, environment and economic dimensions of their life situation.

It has been seen from project practice that it is very easy to bring people together through the cultural bondage created by enactment of 'Streed Theater', popular theatre, Puppetry, Sound slide production, Video films etc. These instruments of participatory methodology strike an emotional chord with the people and they are able to learn the messages while getting entertained. This kind of instruments also help in getting attention of the poorest of the poor and the women. The timing of these enactments must be in the evening when women and the poor are not engaged in their household functions/economic activity. After the show is over the facilitator or the Change Agent should informally interact with the group and can start interaction by getting their response on the issues raised by the enactment or show. This kind of informal interaction helps the poor and the women to shed their inhibitions gradually and they are able to discuss the issues. The facilitator has to move from the peripheral issues to the structural issues gradually which would further lead to the reasons of their present position. Similarly the importance of organising and literacy drive can be brought home to them broadly through the above mentioned media. Later in the group actions activities like poster making and cartoon making should be encouraged to unleash their creative potential. These kind of activities give the poor and the women a feeling of achievement and a forum to be together. The topics of poster and cartoons have to be carefully decided so that awareness generation takes place gradually. The facilitator's endeavour should be to allow the people to think and question the situations. In fact he/she has to develop the analytical ability of the people through such mediums. Attendance in group activities and small achievement of the people must be encouraged so that they continue the endeavour for learning. The facilitator has to have a dialogical approach instead of a one way traffic while interacting with the rural poor. The change agent must believe that social change flows from individual actions. By changing what they do, people move societies in new directions and themselves change (Chambers, 1983)

### *4.7.1 Group Formation*

It has been observed that homogenous groups develop a cultural bondage and develop the strength of cohesion and solidarity. The facilitator will have to be careful in the formation of groups. Homogeneity can be attained through a common factor which could be identified. It would be encouraged to have separate women's groups keeping in view their cultural and social backgrounds. Small groups based on a number of homogenous factors could be encouraged to develop cohesion and solidarity. The common factors pertaining to economic activity deprivation and cultural bondage would encourage groups to identify the commonality of purpose of their cause. This would lead to the strength of the organisation of HRMSs.

## 4.8 Proportionate Representation In MCs

Management Committee (MC) of HRMSs would be constituted by giving proportionate representation to all communities and women. Similarly the MCs Presidentship would also be rotated among various communities. This would be ensured by making suitable amendments in the JFMP Rules. The facilitator would ensure that one or two leaders are not allowed to emerge in groups. For this purpose in routine group activities the work pertaining to leadership would be assigned to all members by rotation. This would help in developing leadership qualities in every member and would make them realise that given a chance they can act as leaders. The leadership would be rotational and would go a long way in strengthening the functioning of the HRMSs. This is also a critical step in holding the HRMSs accountable to the people.

## 4.9 Sensitization Of Officials Of HFD And Administrators

Due to the constant transfers of the field officers, the training of HFD officials will have to be made a constant feature. Even otherwise sensitization for empowering requires refresher courses for up dating the knowledge of the HFD officials. The training/sensitization programme would be a short term programme but would be conducted by the experts in the field of gender and social science. Besides workshops and seminars would be conducted in which not only officers of the HFD but the officers of the district belonging to other departments would be involved. This would not only focus attention of other officers involved in development on JFMP but would also sensitize them. The goal is that the HRMS members should be able to strike a working relationship with the district/state administration so that they ultimately get their share of benefit from the programme.

### *4.9.1 Restructuring SLWG/ DLWGs/ RLWGs*

Presently the PCCF is the chairperson of State Level Working Group (SLWG). Instead of the Principal Chief Conservator of Forest (PCCF), the Secretary Forests to Govt. of Haryana would be made a Chairperson of the SLWG. This is necessitated for the involvement of the government in the programme. Due to the frequent transfers of the senior officers in the state, the new incumbent would become aware of the programme by virtue of being Chairperson. The PCCF would be made Vice Chairman of the SLWG

- It would be essential to have a quarterly meeting of the SLWG
- PCCF would, however, be empowered to call an emergency meeting of the SLWG
- All the HRMSs will be members of the SLWG
- At least 50% Presidents of the HRMSs would be from the deprived classes including scheduled castes
- At least 30% Presidents of the HRMS would be women

### *4.9.2 Agenda Of SLWG*

- Adoption of JFM Rules by the State Cabinet
- Close monitoring of the programme.
- The agenda for the SLWG can be mooted by the representative Presidents of HRMSs either in writing or verbally.
- The HFD and the external support agency can send agenda for SLWG.
- The external agency and HFD would jointly be responsible for convening the meetings of SLWG and issuing the minutes etc.

## Conclusion

This strategy will initiate the process of empowering . It will have a timeframe of three years and during this period the facilitators or the Change Agents would help in preparing rural people to take over the command of the programme. The facilitators will work for a "progressive redundancy" since the process of participation is a "continual dynamic" (Oakley, 1991) it will gradually develop into a movement with the passage of time. The practice of participatory development projects has shown that this kind of development strategies do have an impact in the long run. I do believe what Chambers says "innumerable small steps and tiny pushes, putting the last first, not once but again and again and again. Many small reversals then support each other and together build up towards a great movement"

A word of caution may be added that one must not look for magical transformation of society overnight. As a matter of fact haste in the process of empowering is suicidal to the project. Given the right direction and elements mentioned in the strategy above, the project would unfold the process of empowering which will lead to sustainable development of JFM' as well as of people.

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